

# MARITIME EDUCATION CENTER AND PHASE I SITE WORK

MARITIME HERITAGE FOUNDATION  
THE NORTH CAROLINA MARITIME MUSEUM  
DEPARTMENT OF NATURAL AND CULTURAL RESOURCES

Beaufort, North Carolina 28516

Bid Documents  
Project Manual  
07 June 2024



SCO ID# 24-27956-01A  
CN Commission No: 10145



**CLARK NEXSEN**

421 North Harrington Street, Suite 600  
Raleigh, North Carolina 27603



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Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
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1.1 DESIGN PROFESSIONALS OF RECORD

A. Clark Nexsen Corporate Seal



B. Architect:

1. Donald Kranbuehl, AIA.
2. License #9856.
3. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.



C. Interior Design:

1. Melanie Dover Goodson, IIDA.
2. License #123.
3. Responsible for Divisions 09, 10, 11 & 12.

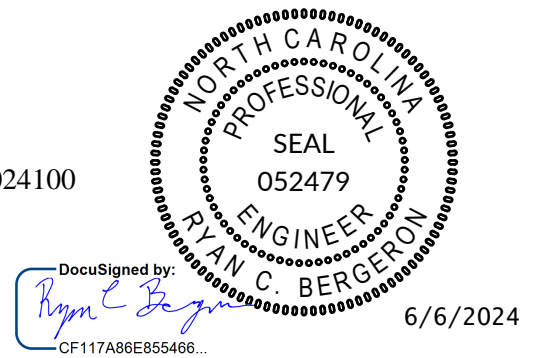


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D. Civil Engineer:

1. Ryan C. Bergeron, PE.
2. License #052479.
3. Responsible for Sections 010400, 015526, 024100  
Divisions 31, 32, & 33.





E. Site/Landscaping Engineer:

1. David A. Amalong, PE.
2. License #2035.
3. Responsible for Sections 057300, 129300, 321220, 321316, 329115, 329200, and 329300.



F. Structural Engineer:

1. Nicole C. Zechman, PE
2. License #052473.
3. Responsible for Sections 033000, 051200, 053100, 061719, and 061800.



G. Fire Protection Engineer:

1. Christopher H. Born, PE.
2. License #22212.
3. Responsible for Division 21 and Section 284621.11.



H. Plumbing Engineer:

1. Anthony W. Brandon, PE.
2. License #023940.
3. Responsible for Division 22.

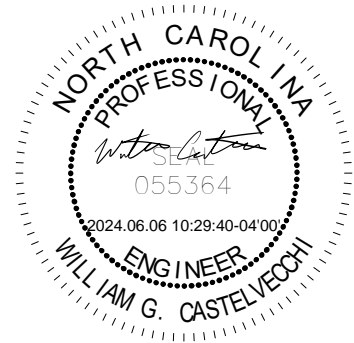


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I. HVAC Engineer:

1. William G. Castelvechi, PE.
2. License #055364.
3. Responsible for Division 23.



J. Electrical Engineer:

1. Patrick J. Rose, PE.
2. License #021538.
3. Responsible for Divisions 26 and 27.



END OF DOCUMENT 000107

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## ADVERTISEMENT FOR BIDS

Sealed proposals will be received until **3:00 PM** on **Monday, August 12, 2024**, at the North Carolina Maritime Museum at 315 Front St, Beaufort, NC for the construction of the **Beaufort Maritime Education Center and Phase I Site Work** at which time and place bids will be opened and read.

Complete plans and specifications may be viewed and ordered online by registering with Sharpe Image Co, <https://sharpeconet.sharepoint.com/sites/ClarkN>. Registration with Sharpe is required to obtain the bid documents and be added to the official Plan Holder's List. Contact Chris Franchi at 919-573-5034 for assistance.

The state reserves the unqualified right to reject any and all proposals.

Signed:

NC Department of Natural and  
Cultural Resources  
919-814-6613

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# NOTICE TO BIDDERS

Sealed proposals will be received by the North Carolina Maritime Museum in Beaufort, NC in the office of Charles Oliver at 315 Front St., Beaufort, NC up to 3:00 pm August 12, 2024 and immediately thereafter publicly opened and read for the furnishing of labor, material and equipment entering into the construction of

## Beaufort Maritime Education Center and Phase I Site Work

An approximately 8,700-sf Maritime Museum Education Center and Ticketing Office, site grading, site utilities, site access, parking, provision for a future music performance stage, and pedestrian and vehicular improvements over approximately 11 acres of land.

Bids will be received for single prime. All proposals shall be lump sum.

## Pre-Bid Meeting

An open pre-bid meeting will be held for all interested bidders on July 9, 2024 at 2:00 PM at the NC Maritime Museum Junior Sailing Classroom at 171 W Beaufort Rd Extension, Beaufort, NC. The meeting will address project specific questions, issues, bidding procedures and bid forms.

Complete plans, specifications and contract documents will be open for inspection in the office of the North Carolina Maritime Museum in Beaufort (contact Charles Oliver, [ucky@jetcraft.com](mailto:ucky@jetcraft.com), 919-349-5588) and the office of Clark Nexsen, Raleigh, NC (contact Allan Kram, [allan.kram@clarknexsen.com](mailto:allan.kram@clarknexsen.com), 919-576-2075) during normal business hours starting on July 2, 2024.

Bid documents will also be available in the plan rooms of:

Dodge Construction Network, 877-784-9556, [support@construction.com](mailto:support@construction.com)

East Coast Digital – Minority Plan Room Provider 703 SE Greenville Blvd, Greenville, NC 27858, 252-758-1616

or may be viewed and ordered online by registering with Sharpe Image Co, <https://sharpeconet.sharepoint.com/sites/ClarkN>. Registration with Sharpe is required to obtain the bid documents and be added to the official Plan Holder's List. Following registration, complete sets of bidding documents may be downloaded from Sharpe's website as "zipped" portable document format (PDF) files. The cost of printed and digital bidding documents and shipping is non-refundable. Addenda will only be notified to those buying full sets from Sharpe via their bid room. Neither owner nor architect will be responsible for copies of the bid documents obtained from sources other than from Sharpe. If you need any assistance ordering or getting registered please contact Chris Franchi at 919-573-5034.

**NOTE:** The bidder shall include with the bid proposal the form *Identification of Minority Business Participation* identifying the minority business participation it will use on the project and shall include either *Affidavit A* or *Affidavit B* as applicable. Forms and instructions are included within the Proposal Form in the bid documents. Failure to complete these forms is grounds for rejection of the bid. (GS143-128.2c Effective 1/1/2002.)

All contractors are hereby notified that they must have proper license as required under the state laws governing their respective trades.

General contractors are notified that Chapter 87, Article 1, General Statutes of North Carolina, will be observed in receiving and awarding general contracts. General contractors submitting bids on this project must have license classification for Unlimited required by the NC General Contractors Licensing Board under G.S. 87-1.

NOTE--SINGLE PRIME CONTRACTS: Under GS 87-1, a contractor that superintends or manages construction of any building, highway, public utility, grading, structure or improvement shall be deemed a "general contractor" and shall be so licensed. Therefore a single prime project that involves other trades will require the single prime contractor to hold a proper General Contractors license. **EXCEPT:** On public buildings being bid single prime, where the total value of the general construction does not exceed 25% of the total construction value, contractors under GS87- Arts 2 and 4 (Plumbing, Mechanical & Electrical) may bid and contract directly with the Owner as the SINGLE PRIME CONTRACTOR and may subcontract to other properly licensed trades. [GS87-1.1- Rules .0210](#)

Each proposal shall be accompanied by a cash deposit or a certified check drawn on some bank or trust company, insured by the Federal Deposit Insurance Corporation, of an amount equal to not less than five percent (5%) of the proposal, or in lieu thereof a bidder may offer a bid bond of five percent (5%) of the bid executed by a surety company licensed under the laws of North Carolina to execute the contract in accordance with the bid bond. Said deposit shall be retained by the owner as liquidated damages in event of failure of the successful bidder to execute the contract within ten days after the award or to give satisfactory surety as required by law.

A performance bond and a payment bond will be required for one hundred percent (100%) of the contract price.

Payment will be made based on ninety-five percent (95%) of monthly estimates and final payment made upon completion and acceptance of work.

No bid may be withdrawn after the scheduled closing time for the receipt of bids for a period of 30 days.

The owner reserves the right to reject any or all bids and to waive informalities.

Designer:  
Clark Nexsen  
421 N. Harrington Street, Suite 600  
Raleigh, NC 27603  
(919) 828-1876

Owner:  
NC Department of Natural and Cultural  
Resources  
109 E Jones St.  
Raleigh, NC 27601  
(919) 814-6613

## SECTION 311505 - EXCAVATION, BACKFILL, AND COMPACTION

### PART 1 GENERAL

#### 1.01. THE REQUIREMENT

- A. Furnish all labor, materials, equipment, and incidentals necessary to perform all excavation, backfill, compaction, and grading required completing the work shown on the Drawings and specified herein.
- B. The work shall include, but not necessarily be limited to excavation, backfilling, grading, compaction, disposal of waste and surplus materials, placing crushed stone, construction of berms, and all related work such as sheeting, bracing, and dewatering.
  - 1. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA excavation safety standards 29 CFR Part 1926.650 Subpart P and State requirements.
    - a. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.
  - 2. Excavated topsoil and excess cut material will be stockpiled in locations approved by the ENGINEER.

#### 1.02. REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents.
  - 1. North Carolina Department of Transportation Standard Specifications for Roads and Structures.
  - 2. ASTM C 127 - Test for Specific Gravity and Absorption of Coarse Aggregate
  - 3. ASTM C 136 -Test for Sieve Analysis of Fine and Coarse Aggregates
  - 4. ASTM D 422 - Particle Size Analysis of Soils
  - 5. ASTM D 423 - Test for Liquid Limit of Soils
  - 6. ASTM D 424 - Test for Plastic Limit and Plasticity Index of Soils
  - 7. ASTM C 535 - Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  - 8. ASTM D 698 - Standard Method of Test for the Moisture - Density Relations of Soils Using a 5.5 lb. (2.5 kg) Rammer and a 12-inch (305 mm) Drop
  - 9. ASTM D1556 - Test for Density of Soil in Place by the Sand-Cone Method
  - 10. ASTM D1557 - Test for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lbs. (4.5 kg) Rammer and 18-inch (457 mm) Drop
  - 11. ASTM D2049 - Test Method for Relative Density of Cohesionless Soils
  - 12. ASTM D2167 - Test for Density of Soil in Place by the Rubber-Balloon Method
  - 13. ASTM D2216 - Test for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures

14. ASTM D2487 - Test for Classification of Soils for Engineering Purposes

15. ASTM D2922 - Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1.03. SUBMITTALS

- A. Excavation support designs shall be prepared by a licensed professional engineer, registered in the State of North Carolina, having a minimum of five years of professional experience in the design and construction of excavation support systems.
- B. Submit a sealed copy of the required Engineering Certification Form in accordance with Section 01 30 00 - Submittals prior to beginning work.

1.04. QUALITY ASSURANCE

A. Codes and Standards

- 1. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Testing and Inspection Services

- 1. Provide access for testing agency to perform soil testing and inspection services for quality control during earthwork operations.
- 2. A testing laboratory approved by the ENGINEER will be employed by the CONTRACTOR and paid by the CONTRACTOR. If included in the PROJECT BID SCHEDULE these costs shall be reimbursable from the Bid Allowance line item established for testing; otherwise, these costs should be included in the price of the work to be completed.
- 3. Allow testing agency to inspect and approve subgrades and fill layers before construction work is performed.

C. Compaction Testing

- 1. The testing agency shall be NCDOT certified.
- 2. Tests will be performed in accordance with applicable NC DOT, ASTM, or AASHTO standard methods, unless otherwise specified.
  - a. The optimum moisture content and the maximum density of each type of material used for structural fill and backfill will be determined in accordance with ASTM D698 or AASHTO T-99.
  - b. The field moisture content of materials being compacted will be determined by ASTM D2216 - Laboratory Determination of Moisture Content of Soil.
  - c. The field density of compacted material will be determined by ASTM D1556 - Test for Density of Soil in Place by the Sand-Cone Method, or by other acceptable in-place density testing method.
- 3. Testing Frequency
  - a. Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. Frequency and location will be chosen by ENGINEER.



- b. Fill improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the OWNER.

#### 1.05. JOB CONDITIONS

- A. Carefully maintain all reference points, property markers, right-of-way markers, benchmarks, etc., and accurately restore if disturbed.
- B. The presence of groundwater in the soil will not constitute a condition for which an increase in the contract price will be made.
- C. Existing Utilities
  1. CONTRACTOR is responsible for locating all utilities and protecting them from damage.
  2. Cooperate with OWNER and utility companies for maintaining services.
  3. Do not break utility connections without notifying utility or OWNER a minimum of 48 hours in advance and providing acceptable temporary services if required.
  4. Repair damage to existing utilities as directed by utility company.

### PART 2 PRODUCTS

#### 2.01. SOIL

- A. Soils for bedding and backfill are described in the ASTM D2487 Figure 1 soils classification chart, and, for purposes of these Specifications, are grouped into five (5) categories as follows, according to their suitability for this application:
  1. Class I Soil - Angular, 6 to 40 mm (¼" to 1½"), graded stone, including several fill materials that have regional significance, such as coral, slag, cinders, crushed stone, and crushed shells.
  2. Class II Soil - Coarse sands and gravels with maximum particle size of 40 mm (1½"), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW, and SP are included in this class.
  3. Class III Soil - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM, and SC are included in this class.
  4. Class IV Soil - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH, and CL are included in this class. These materials are not recommended for bedding, haunching, or initial backfill.
  5. Class V Soil - Includes the organic soils - types OL, OH, and PT, as well as soils containing frozen earth, debris, rocks larger than 1½ inches in diameter, and other foreign materials. These materials are not recommended for bedding, haunching, or initial backfill for any of the accepted pipe materials.

#### 2.02. FILL MATERIALS

- A. Materials for use as fill shall be as described below. The CONTRACTOR shall notify the ENGINEER of the source of each material.

- B. Materials shall be furnished as required from approved off-site sources and hauled to the site.
  - C. Common Fill
    - 1. Common Fill shall consist of mineral soil free from organic materials, loam, wood, trash, and other objectionable materials which may be compressible, or which cannot be properly compacted.
    - 2. Common fill shall not contain stones larger than 4 inches in largest dimension and shall have at least 60% passing the No. 4 sieve, a maximum of 60% passing the No. 200 Sieve, a maximum liquid limit of 60, and a maximum plasticity index of 25.
    - 3. Common Fill shall not contain granite blocks, broken concrete, masonry rubble, or other similar materials.
      - a. It shall have physical properties such that it can be readily spread and compacted during filling.
      - b. Snow, ice, and frozen soil will not be permitted.
  - D. Select Fill
    - 1. Select Fill shall be as specified above for Common Fill except that the material shall contain no stones larger than two inches in largest dimension, a maximum of 50% passing the No. 200 Sieve, a maximum liquid limit of 50 and a maximum plasticity index of 15.
  - E. Structural Fill
    - 1. Structural Fill shall be as specified above for Select Fill except that the material shall have a maximum liquid limit of 40% and a maximum plasticity index of 10 percent.
    - 2. Structural Fill shall be used for roadway shoulder construction as indicated on the Drawings.
  - F. The soils shall be wetted or dried as necessary so that the moisture content during compaction is within 3% of the optimum moisture content as determined by ASTM D698.
  - G. Highly micaceous and elastic silts shall not be used for Common, Select Fill, or Structural Fill.
- 2.03. STONE FOR STABILIZATION OF FOUNDATION
- A. Stone used for pipe bedding and trench stabilization shall meet the gradation requirements of standard aggregate size No. 67 as contained the Standard Specifications for Roads & Structures as published by the NC Department of Transportation, latest edition.
- 2.04. CRUSHED STONE
- A. All crushed stone shall be silica material that is sound, hard, durable, resistant to weathering, as defined by ASTM D2488 and shall be free of overburden, spoil, shale, limestone, and organic material.
  - B. The stone shall be free of deleterious materials such as flat, elongated, friable, decomposed, or micaceous pieces.
    - 1. Broken pieces of concrete, asphalt, or brick are not acceptable.

C. Crushed stone shall be of the size and type shown on the drawings.

2.05. RIP-RAP

A. Provide NCDOT, Class A, B, I or II Rip Rap as shown on the drawings.

B. Rip Rap shall comply with NCDOT Standard Specifications Section 1042 - Riprap.

PART 3 EXECUTION

3.01. GENERAL EXCAVATION

A. General excavation is expected to consist of removing unsuitable soils identified during proofrolling.

1. The bottom of the excavations shall be rendered firm and dry and, in all respects, acceptable to the ENGINEER.

B. Excavation and dewatering shall be accomplished by methods that preserve the undisturbed state of subgrade soils.

1. Soils which become soft, loose, "quick", or otherwise unsatisfactory for support of structures, earthen or man-made, as a result of inadequate excavation, dewatering, proofrolling, or other construction methods shall be removed and replaced as required by the ENGINEER at the CONTRACTOR's expense.

C. Dewatering shall lower the groundwater to at least 1-foot below excavation subgrade and prevent "boiling" condition or detrimental under-seepage at the base of the excavation as specified herein.

D. Excavation equipment shall be satisfactory for carrying out the work in accordance with the Specifications.

E. Proof-roll exposed subgrades after stripping topsoil and organics with a minimum of two complete passes of a rubber tired heavy vehicle as approved by the ENGINEER.

1. All proofrolling shall be conducted in the presence of the ENGINEER.

2. The ENGINEER may require excavation and replacement or other remediation as necessary to provide a firm, stable subgrade in areas that appear to be rutting, pumping, or otherwise appear unstable while proofrolling.

3.02. TRENCH EXCAVATION

A. Excavation for all trenches required for the installation of pipes shall be made to the depths indicated on the Drawings and in such a manner and to such widths as will give suitable room for laying the pipe within the trenches, for bracing and supporting the trench sides and for pumping and drainage facilities.

1. CONTRACTOR shall render the bottom of the excavations firm and stable and in all respects acceptable to the ENGINEER.

2. The trench may be excavated by machinery to, or just below the designated subgrade provided that the material remaining in the bottom of the trench is not disturbed.

3. Where pipe is to be installed in fill, fill shall be placed and compacted to at least 2 ft. above the top of the pipe (rough grade elevation) and then trenches re-excavated for pipe installation.

4. After the trench has been excavated as required to assure the correct invert and a space has been excavated for the pipe bells, lower the pipe into the trench.
5. The pipe shall be placed as near to the center of the trench allowing ample room for compaction on each side.

B. PVC Pipe

1. After excavation is completed, bed with 4 inches of Class I, Class II, or No. 67 stone material to bring trench bottom to grade. Excavated native material may be used if material conforms to this specification.
2. After the joint has been made backfill to spring line of pipe with Class I, Class II, or No. 67 stone material.
3. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.
4. Pipe 3' to 14' of depth
  - a. Continue Class I, Class II, or No. 67 stone material to top of pipe in 8"-12" layers and compact.
5. Pipe 14' to 20' of depth
  - a. Continue Class I, Class II, or No. 67 stone material to 6" above the top of pipe in 8"-12" layers and compact.
6. Pipe greater than 20' of depth
  - a. Continue Class I backfill to 12" above the top of pipe in 8"-12" layers and compact.
7. Backfilling to Grade
  - a. Backfill and compact from the top of embedment material to finished grade with satisfactory soil material, compacting to the density required for the area classification.
  - b. Place backfill in even 8" layers and compact to the density required for the area classification.
  - c. The finished grade shall conform to elevations, slopes, and contours as indicated on the drawings.
  - d. The CONTRACTOR shall be held responsible for settlement over all trenches, and he shall be required to add material and compact as directed if such settlements occur.

C. Ductile Iron Pipe

1. Pipe 3' to 14' of depth
  - a. After excavation and the joint has been made, bed with 4" of Class I, II, III, or IV bedding material. This may be the native trench bottom if material conforms to this specification.

- b. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.
- 2. Pipe 14' to 20' of Depth
  - a. After excavation is completed, bed with 4" of Class I, Class II, or No. 67 stone material to bring trench bottom to grade.
  - b. After the joint has been made backfill to spring line of pipe with Class I, Class II, or No. 67 stone material.
  - c. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.
- 3. Pipe greater than 20' of depth
  - a. After excavation is completed, place 6" of Class I bedding material.
  - b. After the joint has been made, backfill with 4" to 6" of Class I bedding material.
  - c. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.
  - d. Continue Class I backfill to 6" above the top of pipe in 8"-12" layers and compact.
- 4. Backfilling to Grade
  - a. Backfill and compact from the top of embedment material to finished grade with satisfactory soil material, compacting to the density required for the area classification.
  - b. Place backfill in even 8" layers and compact to the density required for the area classification.
  - c. The finished grade shall conform to elevations, slopes, and contours as indicated on the drawings.
  - d. The CONTRACTOR shall be held responsible for settlement over all trenches, and he shall be required to add material and compact as directed if such settlements occur.

### 3.03. ROCK EXCAVATION

- A. Rock Excavation consists of blasting and removal of rock material for establishing the required subgrade elevation for pipe trenches and shall include stockpiling excavated material and subsequent placement or disposal of it.
  - 1. Trench Rock is defined as any material which cannot be practically excavated by a Caterpillar Model No. 330 hydraulic excavator, or equivalent, without the use of hoe-ramming or blasting. Practical excavation is defined as the ability to remove at least 10 cubic yards of material during one hour of continuous digging. This classification does not include material such as loose rock, concrete, or other materials that can be removed by means other than hoe-ramming or blasting, but which for reasons of

economy in excavating, the CONTRACTOR chooses to remove by hoe-ramming or blasting.

- B. Contractor shall excavate and remove rock a minimum of 4 inches below the bottom of the pipe and install appropriate bedding material as defined in these specifications.
- C. If Rock is Classified:
  - 1. It is the responsibility of the CONTRACTOR to establish the top elevation of rock by test digging with an excavator at not greater than 50-foot intervals in the presence of the ENGINEER.
  - 2. The ENGINEER shall then establish the top elevation of the rock layer and compute the quantity of material to be classified as rock, and the CONTRACTOR shall be paid accordingly.
  - 3. There shall be no payment for rock excavated if the ENGINEER has not been notified to prepare measurements and confirm quantities in advance of such excavation.

#### 3.04. BLASTING

- A. Where blasting is necessary to perform the required excavations, the number and size of the charges shall be subject to the acceptance of the ENGINEER.
  - 1. Explosives shall be of such quantity and power and used in such locations as will neither open seams nor otherwise disturb the rock outside the prescribed limits of excavation.
  - 2. As the excavation approaches its final limits, the depth of holes for blasting and the amount of explosives used for each hole shall be reduced so that the underlying or adjacent rock will be neither disturbed nor shattered.
  - 3. No blasting shall be permitted within 50-feet of any existing structure.
  - 4. The CONTRACTOR shall monitor the blasting operations as necessary to ensure that the work is conducted safely and without causing excessive air or ground pressures or displacements.
    - a. This shall include measuring air and ground pressure by the use of two (2) seismographs.
    - b. When blasting, the acceptable level of vibration shall be no higher than 2 inches per second at any structure.
    - c. In residential and commercial areas, one seismograph shall be located near the closest existing structure on the same side of the street as the blast, while the second seismograph shall be located near the closest existing residential structure on the opposite side of the street.
  - 5. A blasting permit shall be obtained from the proper authorities.
  - 6. Permit shall be obtained not less than 24-hours prior to transporting any explosive material or blasting agent.
  - 7. The Fire Department may fix the hours of blasting.
  - 8. Galvanometer shall be employed to check cap circuits.

9. CONTRACTOR shall maintain a blasting log for each and every shot containing not less than the following minimum information:
  - a. Date of shot
  - b. Time of shot
  - c. Crew Supervisor
  - d. Number and depth of holes
  - e. Approximate depth of overburden
  - f. Amount and type of explosive used in each hole
  - g. Type of caps used, i.e., instant or delay
  - h. Weather conditions

10. CONTRACTOR shall furnish ENGINEER with a copy of each blasting log.

3.05. MISCELLANEOUS EXCAVATION

- A. The CONTRACTOR shall perform all excavations necessary for the placing of seeding and plants, for constructing roadways, and any other miscellaneous earth excavation required under this Contract.

3.06. PROTECTION

A. Sheeting and Bracing (if required)

1. Furnish, put in place, and maintain such sheeting and bracing as may be required by Federal, State, and local safety requirements to support the sides of excavations; to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction; and to protect adjacent structures from undermining or other damage.
2. If the ENGINEER is of the opinion that at any location sufficient or proper supports have not been provided, he/she may order additional supports put in, and compliance with such order shall not relieve or release the CONTRACTOR from his/her responsibility for the sufficiency of such supports.
3. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
4. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill.
5. All voids shall be filled to the satisfaction of the ENGINEER. Sheeting and Bracing shall be installed and maintained in accordance with latest OSHA requirements and regulations.
6. Construct the sheeting outside the neat lines of the foundation, unless indicated otherwise, to the extent deemed desirable for the method of operation.
7. Sheeting shall be plumb and securely braced and tied in position.
8. Sheeting and bracing shall be adequate to withstand all pressures to which the structure or trench will be subjected.

9. Any movement or bulging that may occur shall be corrected to provide the necessary clearances and dimensions.
10. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction or other structures, utilities, or property.
11. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand, which must be approved by the ENGINEER, by ramming with tools especially adapted to that purpose, or otherwise as may be directed.
12. The right of the ENGINEER to order sheeting and bracing left in place shall not be construed as creating any obligation on his/her part to issue such orders and his/her failure to exercise his/her right to do so shall not relieve the CONTRACTOR from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the CONTRACTOR to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
13. No sheeting is to be withdrawn if driven below mid-diameter of any pipe and under no circumstances shall any sheeting be cut off at a level lower than 1-ft above the top of any pipe.

B. Drainage and Dewatering

1. At all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water into the excavated areas.
  - a. Groundwater shall be lowered to at least 1-foot below the bottom of excavations.
2. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
  - a. Well or sump installations shall be constructed with proper sand filters to prevent drawing of finer grained soil from the surrounding ground.
3. Surface runoff shall be collected, drained to sumps, and pumped from the disposal unit to maintain an excavation bottom free from standing water.
4. Take all additional precautions to prevent uplift of any structure during construction.
5. Drainage shall be disposed of so that flow or seepage back into the excavated area will be prevented.
6. Flotation shall be prevented by maintaining a positive and continuous operation of the dewatering system. The CONTRACTOR shall be fully responsible and liable for all damages which may result from failure of this system.
7. Remove the dewatering equipment after the system is no longer required.
8. Take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater or surface water quality.

C. Slope Stability



1. The CONTRACTOR shall be solely responsible for the stability of embankments, unbalanced fills, stockpiles, and all other construction operations.

### 3.07. GENERAL BACKFILL

- A. Materials placed in fill areas shall be placed to the lines and grades shown on the Drawings.
  1. Unless otherwise specified, Common Fill shall be used for backfilling.
- B. Fill shall be placed in accordance with the Contract Document.
- C. Material conforming to the requirements of Common Fill shall be placed in layers having a maximum compacted thickness of 8-inches measured before compaction and shall be compacted to at least 95% of its maximum density.
- D. Select Fill shall be used where specified. Select Fill shall be placed in layers having a maximum compacted thickness of 8-inches measured before compaction and shall be compacted to at least 98% of the maximum density.
- E. Structural Fill shall be used where specified and shown on the Drawings.
  1. Structural fill shall be placed in maximum compacted lift thickness of 6 inches and shall be compacted to at least 100% of its maximum density.
- F. The surfaces of filled areas shall be graded to smooth true lines, conforming to grades indicated on the grading plan and no soft spots or uncompacted areas will be allowed in the work.
- G. No compacting shall be done when the material is covered with frost or is frozen or is too wet either from rain or from excess application of water.
  1. At such times, work shall be suspended until the previously placed and new materials have thawed and/or dried sufficiently to permit proper compaction.
- H. All backfill shall be placed at a moisture content within 3% of Standard Proctor (ASTM D698) optimum moisture content

### 3.08. COMPACTION

- A. General
  1. Control soil compaction during construction providing minimum percentage of density specified for each area classification.
- B. Percentage of Maximum Density Requirements
  1. Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with these specifications.
    - a. Structures
      - 1) Compact top 12" of subgrade and each layer of backfill or fill material at 95% maximum dry density.
    - b. Pipes and Related Structures
      - 1) Pipe bedding and embedment material to 90% maximum dry density.

- 2) Backfill and compact trenches in uniform layers from top of bedding and embedment material to finish grade to 95% maximum dry density.
- c. Unpaved Areas
  - 1) Compact top 6" of subgrade and each layer of backfill or fill material at 90% maximum dry density.
- d. Pavements
  - 1) Compact top 12" of subbase and each layer of backfill or fill material at 98% maximum dry density.
- e. Crushed Aggregate Base Course
  - 1) Compact top 12" of subgrade and each 6" layer of crushed aggregate base course material to 100% maximum dry density.
- f. Embankment
  - 1) Compact to a density not less than 95% maximum dry density at moisture contents ranging from -3% to +4% of optimum.
- g. Moisture Control
  - 1) Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, taking care to prevent free water appearing on surface during or subsequent to compaction operations.
  - 2) Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
  - 3) Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry.
  - 4) Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by the soils testing agency.
  - 5) Payment for replacement of material that is too wet to compact will not be considered unless the material is still unsuitable after air-drying.
  - 6) The soils testing agency shall declare which materials are suitable or unsuitable.

### 3.09. ROAD SUBGRADE

- A. The road subgrade for bituminous, concrete, and crushed stone pavement areas in fill sections shall consist of a two-foot-thick layer of Select Fill. The Select Fill shall be placed and compacted in accordance with the contract documents.
- B. The road subgrade for bituminous, concrete, and crushed stone pavement areas in cut sections shall consist of firm natural soils as approved by the ENGINEER.
- C. Road subgrades shall be proof rolled.

### 3.10. HANDLING OF SURPLUS MATERIAL

- A. Excavated materials shall not be removed from the site except as specified by the ENGINEER.

1. Materials shall be neatly stockpiled on-site at locations directed by the OWNER.
2. Excess materials shall be compacted and stockpiled in accordance with the CONTRACTOR's fill placement plan.
3. CONTRACTOR shall provide erosion and sedimentation control measures as shown on the drawings and specified in the Contract Documents.

END OF SECTION 311505



**DOCUMENT 00 72 13G  
SUPPLEMENTARY CONDITIONS**

General:

The Supplementary Instructions to Bidders and General Conditions contains changes and additions to the "General Conditions of the Contract, Standard Form for Construction Projects", State of North Carolina, Department of Administration, Division of State Construction, Form OC-15, **January 2013 Edition**. Where any portion of an article in the aforementioned General Conditions is modified or voided by the Supplementary Conditions, the unaltered provisions shall remain in effect.

**GENERAL CONDITIONS OF THE CONTRACT**

**ARTICLE 1 – DEFINITIONS**

- (c) Modify to read: The Designer referred to herein, shall mean Clark Nexsen, 421 North Harrington Street, Raleigh, NC 27603

Delete the second sentence and replace with the following: The Designer(s) referred to herein shall mean architect or engineer, and throughout the documents the word designer shall mean Designer.

- (f) Add to the end of the paragraph: Written notice to include fax or e-mail copy with confirmation of receipt.
- (s) Add to the end of the paragraph: **Acceptance** of equal is subject to approval of Designer
- (t) Add to the end of the paragraph: **Acceptance** of substitution is subject to approval of Designer
- (u) Add the following new paragraph: **Provide** shall mean furnish and install complete in place, new, clean, operational, and ready for use.
- (v) Add the following new paragraph: **Indicated** and **shown** shall mean provide as detailed, or called for, and reasonably implied in the contract documents.
- (cc) Add the following new paragraph: **Latest edition** shall mean the current printed version of the referenced document issued up to 30 calendar days prior to date of receipt of bids, unless specified otherwise.

**ARTICLE 5 – SHOP DRAWINGS, SUBMITTAL, SAMPLES, DATA**

- (b) Revise to read as follows: The Contractor shall review, approve and submit to the Designer all Shop or Setting Drawings, Coordination Drawings, Product Data, Samples, Color Charts, and similar submittal data required or reasonably implied by the Contract Documents. Required Submittals shall bear the Contractor's stamp of approval, any exceptions to the Contract Documents shall be noted on the submittals. Submittals shall be presented to the Designer with reasonable promptness and time so as to cause no delay in the activities.

**ARTICLE 10 – PERMITS, INSPECTIONS, FEES, REGULATIONS**

- (f) Add the following new paragraph: Construction Manager shall be responsible for tap fees and fees shall be included in the bid proposal.

#### ARTICLE 14 – CONSTRUCTION SUPERVISION AND SCHEDULE

- (f) Revise paragraph and subparagraphs to read as follows: The Single Prime Contractor is the Project Expediter. See General Conditions Article 1i.
- (g) Revise paragraph to read as follows: It shall be the responsibility of the Project Expediter to cooperate with and obtain from subcontractors on the job, their respective work activities and integrate these activities into a project construction schedule in form of a Critical Path Method (CPM), schedule. The project construction schedule shall graphically show all salient features of the work required to construct the project from start to finish and within the early completion and contractual completion dates is part of the project total float time; and shall be used as such, unless amended by a change order. The complete Project construction schedule shall be of the type set forth in the Supplementary General Condition or subparagraph below, as appropriate:
1. For a project with total contracts over \$500,000, a Critical Path Method (CPM) schedule shall be utilized to control the planning and scheduling of the Work. The CPM schedule shall be the responsibility of the Project Expediter and shall be paid for by the Project Expediter.
- (i) Revise paragraph to read as follows: Designation as Project Expediter entails an additional project control responsibility and does not alter in any way the responsibility of the contractor so designated, nor the responsibility of the other contractors involved in the project. The Contractor's Superintendent shall be in attendance at the Project site not less than eight (8) hours per day, five (5) days per week unless the job is closed down due to a general strike or conditions beyond the control of the Construction Manager or until termination of the Contract in accordance with the Contract Documents. It is understood that such Superintendent shall be acceptable to the Owner and Designer and shall be the one who will be continued in that capacity for the duration of the project unless he ceases to be on the Contractor's payroll, or the Owner otherwise agrees. The Superintendent shall not be employed on any other project for or by the Contractor or by any other entity during the course of the Work. If the Superintendent is employed by the Contractor on another project without the Owner's approval, then the Owner may deduct from the Contractor's monthly general condition costs an amount representing the Superintendent's cost and shall deduct that amount for each month thereafter until the Contractor has the Superintendent back on the Owner's project full-time.

#### ARTICLE 23 – TIME OF COMPLETION, DELAYS, EXTENSION OF TIME

- (b) Revise paragraph to read as follows: The Contractor shall commence work to be performed under this agreement on a date to be specified in a written Notice to Proceed from the designer and shall fully complete all work hereunder within 365 **consecutive calendar days** from, and including said date. For each day in excess of the above number of days, the Construction Manager shall pay the Owner the sum equal to **\$\$1,000.00 per day thereafter as liquidated damages** reasonably estimated in advance to cover the losses to be incurred by the Owner by reason of failure of said Contractor to complete the work within the time specified, such time being in the essence of this contract and a material consideration thereof.

- (d) Add the following to the end of the paragraph: Time extensions for weather delays, acts of God, labor disputes, fire, delays in transportation, unavoidable casualties or other delays which are beyond the control of the Owner do not entitle the Contractor to "extended overhead" recovery.

#### ARTICLE 34 – MINIMUM INSURANCE REQUIREMENTS

Modify first paragraph to read: The work under this contract shall not commence until the Contractor has obtained all required insurance and verifying certificates have been approved in writing by the Owner to include the required cancellation provision. The insurance certificate(s) must have inserted in the insurance certificate block provided for Special Provisions the following: "Notwithstanding the preprinted cancellation provisions on this form, coverages afforded under the policies will not be cancelled, reduced in amount, nor will any coverages be eliminated until at least thirty (30) days after mailing written notice, by certified mail, return receipt requested, to the insured and the owner, of such alternation or cancellation."

- (c) Modify paragraph to read: "The Contractor shall purchase and maintain property insurance during the life of this contract, upon the entire work at the site to the full insurable value thereof. This insurance shall include the interests of the Owner, the Contractor, the subcontractors and sub-subcontractors in the work and shall insure **against risks of direct physical loss – (all perils)**. If the owner is damaged by failure of the Contractor to purchase or maintain such insurance, then the Contractor shall bear all reasonable costs properly attributable thereto; the Contractor shall effect and maintain similar property insurance on portions of the work stored off the site when request for payment per articles so includes such portions."

#### ARTICLE 38 – USE OF PREMISES

- (d) Add to the end of the paragraph: Contractor shall post a sign indicating Firearms are prohibited on the campus.

#### ARTICLE 40 – UTILITIES, STRUCTURES, SIGNS

- (a) Amend paragraph as follows: The Contractor shall provide necessary and adequate facilities for water, electricity, gas, oil, sewer, and other utility services which may be necessary and required for completion of the project including all utilities required for testing, cleaning, balancing, and sterilization of designated plumbing, mechanical and electrical systems. Where existing power and water are available in the project area, the Contractor is free to use those utilities in the work. Any new utilities and permanent meters installed shall be listed in the Contractor's name until work is fully accepted by the Owner. The Contractor will be solely responsible for all new utility costs prior to Final Acceptance. Contractor shall contact all affected utility companies prior to the bid to determine their requirements to provide temporary and permanent service and include all cost associated with providing those services in their bid. Coordination of the work of the utility companies during construction is the sole responsibility of the Contractor.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

**ARTICLE 41 – CLEANING UP**

- (b) Add to the end of the paragraph: The Contractor shall install and maintain a mud free graveled or rocked drive from pavement to the building at the beginning of construction for the use of all contractors until permanent site access is installed.

**END OF DOCUMENT**



# **GUIDELINES FOR RECRUITMENT AND SELECTION OF MINORITY BUSINESSES FOR PARTICIPATION IN STATE CONSTRUCTION CONTRACTS**

In accordance with G.S. 143-128.2 (effective January 1, 2002) these guidelines establish goals for minority participation in single-prime bidding, separate-prime bidding, construction manager at risk, and alternative contracting methods, on State construction projects in the amount of \$300,000 or more. The legislation provides that the State shall have a verifiable ten percent (10%) goal for participation by minority businesses in the total value of work for each project for which a contract or contracts are awarded. These requirements are published to accomplish that end.

## **SECTION A: INTENT**

It is the intent of these guidelines that the State of North Carolina, as awarding authority for construction projects, and the contractors and subcontractors performing the construction contracts awarded shall cooperate and in good faith do all things legal, proper and reasonable to achieve the statutory goal of ten percent (10%) for participation by minority businesses in each construction project as mandated by GS 143-128.2. Nothing in these guidelines shall be construed to require contractors or awarding authorities to award contracts or subcontracts to or to make purchases of materials or equipment from minority-business contractors or minority-business subcontractors who do not submit the lowest responsible, responsive bid or bids.

## **SECTION B: DEFINITIONS**

1. Minority - a person who is a citizen or lawful permanent resident of the United States and who is:
  - a. Black, that is, a person having origins in any of the black racial groups in Africa;
  - b. Hispanic, that is, a person of Spanish or Portuguese culture with origins in Mexico, South or Central America, or the Caribbean Islands, regardless of race;
  - c. Asian American, that is, a person having origins in any of the original peoples of the Far East, Southeast Asia and Asia, the Indian subcontinent, the Pacific Islands;
  - d. American Indian, that is, a person having origins in any of the original peoples of North America; or
  - e. Female
2. Minority Business - means a business:
  - a. In which at least fifty-one percent (51%) is owned by one or more minority persons, or in the case of a corporation, in which at least fifty-one percent (51%) of the stock is owned by one or more minority persons or socially and economically disadvantaged individuals; and
  - b. Of which the management and daily business operations are controlled by one or more of the minority persons or socially and economically disadvantaged individuals who own it.
3. Socially and economically disadvantaged individual - means the same as defined in 15 U.S.C. 637. "Socially disadvantaged individuals are those who have been subjected to racial or ethnic prejudice or cultural bias because of their identity as a member of a group without regard to their individual qualities". "Economically disadvantaged individuals are those socially disadvantaged individuals whose ability to compete in the free enterprise system has been impaired due to diminished capital and credit opportunities as compared to others in the same business area who are not socially disadvantaged".
4. Public Entity - means State and all public subdivisions and local governmental units.
5. Owner - The State of North Carolina, through the Agency/Institution named in the contract.
6. Designer - Any person, firm, partnership, or corporation, which has contracted with the State of North Carolina to perform architectural or engineering, work.
7. Bidder - Any person, firm, partnership, corporation, association, or joint venture seeking to be awarded a public contract or subcontract.

8. Contract - A mutually binding legal relationship or any modification thereof obligating the seller to furnish equipment, materials or services, including construction, and obligating the buyer to pay for them.
9. Contractor - Any person, firm, partnership, corporation, association, or joint venture which has contracted with the State of North Carolina to perform construction work or repair.
10. Subcontractor - A firm under contract with the prime contractor or construction manager at risk for supplying materials or labor and materials and/or installation. The subcontractor may or may not provide materials in his subcontract.

## **SECTION C: RESPONSIBILITIES**

1. Office for Historically Underutilized Businesses, Department of Administration (hereinafter referred to as HUB Office).

The HUB Office has established a program, which allows interested persons or businesses qualifying as a minority business under G.S. 143-128.2, to obtain certification in the State of North Carolina procurement system. The information provided by the minority businesses will be used by the HUB Office to:

- a. Identify those areas of work for which there are minority businesses, as requested.
- b. Make available to interested parties a list of prospective minority business contractors and subcontractors.
- c. Assist in the determination of technical assistance needed by minority business contractors.

In addition to being responsible for the certification/verification of minority businesses that want to participate in the State construction program, the HUB Office will:

- (1) Maintain a current list of minority businesses. The list shall include the areas of work in which each minority business is interested.
- (2) Inform minority businesses on how to identify and obtain contracting and subcontracting opportunities through the State Construction Office and other public entities.
- (3) Inform minority businesses of the contracting and subcontracting process for public construction building projects.
- (4) Work with the North Carolina trade and professional organizations to improve the ability of minority businesses to compete in the State construction projects.
- (5) The HUB Office also oversees the minority business program by:
  - a. Monitoring compliance with the program requirements.
  - b. Assisting in the implementation of training and technical assistance programs.
  - c. Identifying and implementing outreach efforts to increase the utilization of minority businesses.
  - d. Reporting the results of minority business utilization to the Secretary of the Department of Administration, the Governor, and the General Assembly.

2. State Construction Office

The State Construction Office will be responsible for the following:

- a. Furnish to the HUB Office a minimum of twenty-one days prior to the bid opening the following:
  - (1) Project description and location;
  - (2) Locations where bidding documents may be reviewed;
  - (3) Name of a representative of the owner who can be contacted during the advertising period to advise who the prospective bidders are;
  - (4) Date, time and location of the bid opening.
  - (5) Date, time and location of prebid conference, if scheduled.
- b. Attending scheduled prebid conference, if necessary, to clarify requirements of the general statutes regarding minority-business participation, including the bidders' responsibilities.

- c. Reviewing the apparent low bidders' statutory compliance with the requirements listed in the proposal, that must be complied with, if the bid is to be considered as responsive, prior to award of contracts. The State reserves the right to reject any or all bids and to waive informalities.
- d. Reviewing of minority business requirements at Preconstruction conference.
- e. Monitoring of contractors' compliance with minority business requirements in the contract documents during construction.
- f. Provide statistical data and required reports to the HUB Office.
- g. Resolve any protest and disputes arising after implementation of the plan, in conjunction with the HUB Office.

### 3. Owner

Before awarding a contract, owner shall do the following:

- a. Develop and implement a minority business participation outreach plan to identify minority businesses that can perform public building projects and to implement outreach efforts to encourage minority business participation in these projects to include education, recruitment, and interaction between minority businesses and non-minority businesses.
- b. Attend the scheduled prebid conference.
- c. At least 10 days prior to the scheduled day of bid opening, notify minority businesses that have requested notices from the public entity for public construction or repair work and minority businesses that otherwise indicated to the Office for Historically Underutilized Businesses an interest in the type of work being bid or the potential contracting opportunities listed in the proposal. The notification shall include the following:
  - 1. A description of the work for which the bid is being solicited.
  - 2. The date, time, and location where bids are to be submitted.
  - 3. The name of the individual within the owner's organization who will be available to answer questions about the project.
  - 4. Where bid documents may be reviewed.
  - 5. Any special requirements that may exist.
- d. Utilize other media, as appropriate, likely to inform potential minority businesses of the bid being sought.
- e. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
- f. Review, jointly with the designer, all requirements of G.S. 143-128.2(c) and G.S. 143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with corresponding total dollar value of the bid and affidavit listing good faith efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award to the State Construction Office.
- g. Evaluate documentation to determine good faith effort has been achieved for minority business utilization prior to recommendation of award to State Construction Office.
- h. Review prime contractors' pay applications for compliance with minority business utilization commitments prior to payment.
- i. Make documentation showing evidence of implementation of Owner's responsibilities available for review by State Construction Office and HUB Office, upon request

### 4. Designer

Under the single-prime bidding, separate prime bidding, construction manager at risk, or alternative contracting method, the designer will:

- a. Attend the scheduled prebid conference to explain minority business requirements to the prospective bidders.
- b. Assist the owner to identify and notify prospective minority business prime and subcontractors of potential contracting opportunities.
- c. Maintain documentation of any contacts, correspondence, or conversation with minority business firms made in an attempt to meet the goals.
- d. Review jointly with the owner, all requirements of G.S. 143-128.2(c) and G.S. 143-128.2(f) – (i.e. bidders' proposals for identification of the minority businesses that will be utilized with

corresponding total dollar value of the bid and affidavit listing Good Faith Efforts, or affidavit of self-performance of work, if the contractor will perform work under contract by its own workforce) - prior to recommendation of award.

- e. During construction phase of the project, review “MBE Documentation for Contract Payment” – (Appendix E) for compliance with minority business utilization commitments. Submit Appendix E form with monthly pay applications to the owner and forward copies to the State Construction Office.
- f. Make documentation showing evidence of implementation of Designer’s responsibilities available for review by State Construction Office and HUB Office, upon request.

5. Prime Contractor(s), CM at Risk, and Its First-Tier Subcontractors

Under the single-prime bidding, the separate-prime bidding, construction manager at risk and alternative contracting methods, contractor(s) will:

- a. Attend the scheduled prebid conference.
- b. Identify or determine those work areas of a subcontract where minority businesses may have an interest in performing subcontract work.
- c. At least ten (10) days prior to the scheduled day of bid opening, notify minority businesses of potential subcontracting opportunities listed in the proposal. The notification will include the following:
  - (1) A description of the work for which the subbid is being solicited.
  - (2) The date, time and location where subbids are to be submitted.
  - (3) The name of the individual within the company who will be available to answer questions about the project.
  - (4) Where bid documents may be reviewed.
  - (5) Any special requirements that may exist, such as insurance, licenses, bonds and financial arrangements.

If there are more than three (3) minority businesses in the general locality of the project who offer similar contracting or subcontracting services in the specific trade, the contractor(s) shall notify three (3), but may contact more, if the contractor(s) so desires.

- d. During the bidding process, comply with the contractor(s) requirements listed in the proposal for minority participation.
- e. Identify on the bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit listing good faith efforts as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).
- f. Make documentation showing evidence of implementation of PM, CM-at-Risk and First-Tier Subcontractor responsibilities available for review by State Construction Office and HUB Office, upon request.
- g. Upon being named the apparent low bidder, the Bidder shall provide one of the following: (1) an affidavit (Affidavit C) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal; (2) if the percentage is not equal to the applicable goal, then documentation of all good faith efforts taken to meet the goal. Failure to comply with these requirements is grounds for rejection of the bid and award to the next lowest responsible and responsive bidder.
- h. The contractor(s) shall identify the name(s) of minority business subcontractor(s) and corresponding dollar amount of work on the schedule of values. The schedule of values shall be provided as required in Article 31 of the General Conditions of the Contract to facilitate payments to the subcontractors.
- i. The contractor(s) shall submit with each monthly pay request(s) and final payment(s), “MBE Documentation for Contract Payment” – (Appendix E), for designer’s review.
- j. During the construction of a project, at any time, if it becomes necessary to replace a minority business subcontractor, immediately advise the owner, State Construction Office, and the Director of the HUB Office in writing, of the circumstances involved. The prime contractor shall make a good faith effort to replace a minority business subcontractor with another minority business subcontractor.

- k. If during the construction of a project additional subcontracting opportunities become available, make a good faith effort to solicit subbids from minority businesses.
- l. It is the intent of these requirements apply to all contractors performing as prime contractor and first tier subcontractor under construction manager at risk on state projects.

6. Minority Business Responsibilities

While minority businesses are not required to become certified in order to participate in the State construction projects, it is recommended that they become certified and should take advantage of the appropriate technical assistance that is made available. In addition, minority businesses who are contacted by owners or bidders must respond promptly whether or not they wish to submit a bid.

**SECTION 4: DISPUTE PROCEDURES**

It is the policy of this state that disputes that involves a person's rights, duties or privileges, should be settled through informal procedures. To that end, minority business disputes arising under these guidelines should be resolved as governed under G.S. 143-128(g).

**SECTION 5:** These guidelines shall apply upon promulgation on state construction projects. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: [www.nc-sco.com](http://www.nc-sco.com)

**SECTION 6:** In addition to these guidelines, there will be issued with each construction bid package provisions for contractual compliance providing minority business participation in the state construction program.

## MINORITY BUSINESS CONTRACT PROVISIONS (CONSTRUCTION)

### APPLICATION:

The **Guidelines for Recruitment and Selection of Minority Businesses for Participation in State Construction Contracts** are hereby made a part of these contract documents. These guidelines shall apply to all contractors regardless of ownership. Copies of these guidelines may be obtained from the Department of Administration, State Construction Office, (physical address) 301 North Wilmington Street, Suite 450, NC Education Building, Raleigh, North Carolina, 27601-2827, (mail address) 1307 Mail Service Center, Raleigh, North Carolina, 27699-1307, phone (919) 807-4100, Website: <http://www.nc-sco.com>

### MINORITY BUSINESS SUBCONTRACT GOALS:

The goals for participation by minority firms as subcontractors on this project have been set at 10%.

The bidder must identify on its bid, the minority businesses that will be utilized on the project with corresponding total dollar value of the bid and affidavit (Affidavit A) listing good faith efforts or affidavit (Affidavit B) of self-performance of work, if the bidder will perform work under contract by its own workforce, as required by G.S. 143-128.2(c) and G.S. 143-128.2(f).

The lowest responsible, responsive bidder must provide Affidavit C, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the applicable goal.

**OR**

Provide Affidavit D, that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, **with documentation of Good Faith Effort, if the percentage is not equal to the applicable goal.**

**OR**

Provide Affidavit B, which includes sufficient information for the State to determine that the bidder does not customarily subcontract work on this type project.

**The above information must be provided as required. Failure to submit these documents is grounds for rejection of the bid.**

## **MINIMUM COMPLIANCE REQUIREMENTS:**

All written statements, affidavits or intentions made by the Bidder shall become a part of the agreement between the Contractor and the State for performance of this contract. Failure to comply with any of these statements, affidavits or intentions, or with the minority business Guidelines shall constitute a breach of the contract. A finding by the State that any information submitted either prior to award of the contract or during the performance of the contract is inaccurate, false or incomplete, shall also constitute a breach of the contract. Any such breach may result in termination of the contract in accordance with the termination provisions contained in the contract. It shall be solely at the option of the State whether to terminate the contract for breach.

In determining whether a contractor has made Good Faith Efforts, the State will evaluate all efforts made by the Contractor and will determine compliance in regard to quantity, intensity, and results of these efforts. Good Faith Efforts include:

- (1) Contacting minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor or available on State or local government maintained lists at least 10 days before the bid or proposal date and notifying them of the nature and scope of the work to be performed.
- (2) Making the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bid or proposals are due.
- (3) Breaking down or combining elements of work into economically feasible units to facilitate minority participation.
- (4) Working with minority trade, community, or contractor organizations identified by the Office for Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- (5) Attending any prebid meetings scheduled by the public owner.
- (6) Providing assistance in getting required bonding or insurance or providing alternatives to bonding or insurance for subcontractors.
- (7) Negotiating in good faith with interested minority businesses and not rejecting them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- (8) Providing assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisting minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- (9) Negotiating joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- (10) Providing quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

## APPENDIX E

### MBE DOCUMENTATION FOR CONTRACT PAYMENTS

Prime Contractor/Architect: \_\_\_\_\_

Address & Phone: \_\_\_\_\_

Project Name: \_\_\_\_\_

Pay Application #: \_\_\_\_\_ Period: \_\_\_\_\_

The following is a list of payments made to Minority Business Enterprises on this project for the above-mentioned period.

MBE FIRM NAME	* INDICATE TYPE OF MBE	AMOUNT PAID THIS MONTH	TOTAL PAYMENTS TO DATE	TOTAL AMOUNT COMMITTED

\*Minority categories: Black, African American (B), Hispanic (H), Asian American (A), American Indian (I), Female (F), Social and Economically Disadvantage (D)

Date: \_\_\_\_\_ Approved/Certified By: \_\_\_\_\_

Name

\_\_\_\_\_  
Title

\_\_\_\_\_  
Signature

**SUBMIT WITH EACH PAY REQUEST & FINAL PAYMENT**



## Identification of HUB Certified/ Minority Business Participation

\_\_\_\_\_  
(Name of Bidder)

do hereby certify that on this project, we will use the following HUB Certified/ minority business as construction subcontractors, vendors, suppliers or providers of professional services.

Firm Name, Address and Phone #

### Work Type

\*Minority  
Category

\*\*HUB  
Certified  
(Y/N)[illegible]

\*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**\*\* HUB Certification with the state HUB Office required to be counted toward state participation goals.**

**The total value of minority business contracting will be (\$)**\_\_\_\_\_.

# State of North Carolina AFFIDAVIT A – Listing of Good Faith Efforts

County of \_\_\_\_\_

(Name of Bidder)

Affidavit of \_\_\_\_\_

I have made a good faith effort to comply under the following areas checked:

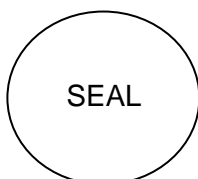
**Bidders must earn at least 50 points from the good faith efforts listed for their bid to be considered responsive.** (1 NC Administrative Code 30 I.0101)

- ☐ **1 – (10 pts)** Contacted minority businesses that reasonably could have been expected to submit a quote and that were known to the contractor, or available on State or local government maintained lists, at least 10 days before the bid date and notified them of the nature and scope of the work to be performed.
- ☐ **2 --(10 pts)** Made the construction plans, specifications and requirements available for review by prospective minority businesses, or providing these documents to them at least 10 days before the bids are due.
- ☐ **3 – (15 pts)** Broken down or combined elements of work into economically feasible units to facilitate minority participation.
- ☐ **4 – (10 pts)** Worked with minority trade, community, or contractor organizations identified by the Office of Historically Underutilized Businesses and included in the bid documents that provide assistance in recruitment of minority businesses.
- ☐ **5 – (10 pts)** Attended prebid meetings scheduled by the public owner.
- ☐ **6 – (20 pts)** Provided assistance in getting required bonding or insurance or provided alternatives to bonding or insurance for subcontractors.
- ☐ **7 – (15 pts)** Negotiated in good faith with interested minority businesses and did not reject them as unqualified without sound reasons based on their capabilities. Any rejection of a minority business based on lack of qualification should have the reasons documented in writing.
- ☐ **8 – (25 pts)** Provided assistance to an otherwise qualified minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letters of credit, including waiving credit that is ordinarily required. Assisted minority businesses in obtaining the same unit pricing with the bidder's suppliers in order to help minority businesses in establishing credit.
- ☐ **9 – (20 pts)** Negotiated joint venture and partnership arrangements with minority businesses in order to increase opportunities for minority business participation on a public construction or repair project when possible.
- ☐ **10 - (20 pts)** Provided quick pay agreements and policies to enable minority contractors and suppliers to meet cash-flow demands.

The undersigned, if apparent low bidder, will enter into a formal agreement with the firms listed in the Identification of Minority Business Participation schedule conditional upon scope of contract to be executed with the Owner. Substitution of contractors must be in accordance with GS143-128.2(d) Failure to abide by this statutory provision will constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of the minority business commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_  
 Signature: \_\_\_\_\_  
 Title: \_\_\_\_\_



State of \_\_\_\_\_, County of \_\_\_\_\_  
 Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_  
 Notary Public \_\_\_\_\_  
 My commission expires \_\_\_\_\_

**State of North Carolina --AFFIDAVIT B-- Intent to Perform Contract  
with Own Workforce.**

County of \_\_\_\_\_

Affidavit of \_\_\_\_\_  
(Name of Bidder)

I hereby certify that it is our intent to perform 100% of the work required for the \_\_\_\_\_  
\_\_\_\_\_ contract.  
(Name of Project)

In making this certification, the Bidder states that the Bidder does not customarily subcontract elements of this type project, and normally performs and has the capability to perform and will perform all elements of the work on this project with his/her own current work forces; and

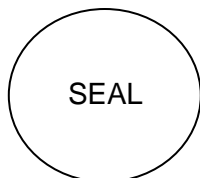
The Bidder agrees to provide any additional information or documentation requested by the owner in support of the above statement. The Bidder agrees to make a Good Faith Effort to utilize minority suppliers where possible.

The undersigned hereby certifies that he or she has read this certification and is authorized to bind the Bidder to the commitments herein contained.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_



State of \_\_\_\_\_, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_

# State of North Carolina - AFFIDAVIT C - Portion of the Work to be Performed by HUB Certified/Minority Businesses

County of \_\_\_\_\_

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the portion of the work to be executed by HUB certified/minority businesses as defined in GS143-128.2(g) and 128.4(a),(b),(e) is equal to or greater than 10% of the bidders total contract price, then the bidder must complete this affidavit.

This affidavit shall be provided by the apparent lowest responsible, responsive bidder within **72 hours** after notification of being low bidder.

Affidavit of \_\_\_\_\_ I do hereby certify that on the  
(Name of Bidder)

(Project Name)  
Project ID# \_\_\_\_\_ Amount of Bid \$ \_\_\_\_\_

I will expend a minimum of \_\_\_\_\_% of the total dollar amount of the contract with minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. Attach additional sheets if required

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

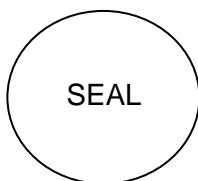
\*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**\*\* HUB Certification with the state HUB Office required to be counted toward state participation goals.**

Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_



Signature: \_\_\_\_\_

Title: \_\_\_\_\_

State of \_\_\_\_\_, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_

# State of North Carolina AFFIDAVIT D – Good Faith Efforts

County of \_\_\_\_\_

(Note this form is to be submitted only by the apparent lowest responsible, responsive bidder.)

If the goal of 10% participation by HUB Certified/ minority business **is not** achieved, the Bidder shall provide the following documentation to the Owner of his good faith efforts:

Affidavit of \_\_\_\_\_ I do hereby certify that on the \_\_\_\_\_  
(Name of Bidder)

Project ID# \_\_\_\_\_ (Project Name) Amount of Bid \$ \_\_\_\_\_

I will expend a minimum of \_\_\_\_\_% of the total dollar amount of the contract with HUB certified/ minority business enterprises. Minority businesses will be employed as construction subcontractors, vendors, suppliers or providers of professional services. Such work will be subcontracted to the following firms listed below. (Attach additional sheets if required)

Name and Phone Number	*Minority Category	**HUB Certified Y/N	Work Description	Dollar Value

\*Minority categories: Black, African American (**B**), Hispanic (**H**), Asian American (**A**) American Indian (**I**), Female (**F**) Socially and Economically Disadvantaged (**D**)

**\*\* HUB Certification with the state HUB Office required to be counted toward state participation goals.**

**Examples** of documentation that may be required to demonstrate the Bidder's good faith efforts to meet the goals set forth in these provisions include, but are not necessarily limited to, the following:

- Copies of solicitations for quotes to at least three (3) minority business firms from the source list provided by the State for each subcontract to be let under this contract (if 3 or more firms are shown on the source list). Each solicitation shall contain a specific description of the work to be subcontracted, location where bid documents can be reviewed, representative of the Prime Bidder to contact, and location, date and time when quotes must be received.
- Copies of quotes or responses received from each firm responding to the solicitation.
- A telephone log of follow-up calls to each firm sent a solicitation.
- For subcontracts where a minority business firm is not considered the lowest responsible sub-bidder, copies of quotes received from all firms submitting quotes for that particular subcontract.
- Documentation of any contacts or correspondence to minority business, community, or contractor organizations in an attempt to meet the goal.
- Copy of pre-bid roster
- Letter documenting efforts to provide assistance in obtaining required bonding or insurance for minority business.
- Letter detailing reasons for rejection of minority business due to lack of qualification.
- Letter documenting proposed assistance offered to minority business in need of equipment, loan capital, lines of credit, or joint pay agreements to secure loans, supplies, or letter of credit, including waiving credit that is ordinarily required.

Failure to provide the documentation as listed in these provisions may result in rejection of the bid and award to the next lowest responsible and responsive bidder.

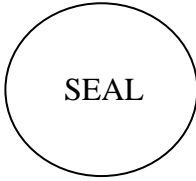
Pursuant to GS143-128.2(d), the undersigned will enter into a formal agreement with Minority Firms for work listed in this schedule conditional upon execution of a contract with the Owner. Failure to fulfill this commitment may constitute a breach of the contract.

The undersigned hereby certifies that he or she has read the terms of this commitment and is authorized to bind the bidder to the commitment herein set forth.

Date: \_\_\_\_\_ Name of Authorized Officer: \_\_\_\_\_

Signature: \_\_\_\_\_

Title: \_\_\_\_\_



State of \_\_\_\_\_, County of \_\_\_\_\_

Subscribed and sworn to before me this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_

Notary Public \_\_\_\_\_

My commission expires \_\_\_\_\_

## FORM OF BID BOND

KNOW ALL MEN BY THESE PRESENTS THAT \_\_\_\_\_

\_\_\_\_\_ as principal, and \_\_\_\_\_, as surety, who is duly licensed to act as surety in North Carolina, are held and firmly bound unto the State of North Carolina through \_\_\_\_\_ as obligee, in the penal sum of \_\_\_\_\_ DOLLARS, lawful money of the United States of America, for the payment of which, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

Signed, sealed and dated this \_\_\_\_ day of \_\_\_\_ 20\_\_

WHEREAS, the said principal is herewith submitting proposal for  
and the principal desires to file this bid bond in lieu of making  
the cash deposit as required by G.S. 143-129.

NOW, THEREFORE, THE CONDITION OF THE ABOVE OBLIGATION is such, that if the principal shall be awarded the contract for which the bid is submitted and shall execute the contract and give bond for the faithful performance thereof within ten days after the award of same to the principal, then this obligation shall be null and void; but if the principal fails to so execute such contract and give performance bond as required by G.S. 143-129, the surety shall, upon demand, forthwith pay to the obligee the amount set forth in the first paragraph hereof. Provided further, that the bid may be withdrawn as provided by G.S. 143-129.1

\_\_\_\_\_(SEAL)

\_\_\_\_\_(SEAL)

\_\_\_\_\_(SEAL)

\_\_\_\_\_(SEAL)

\_\_\_\_\_(SEAL)





## FORM OF CONSTRUCTION CONTRACT

(ALL PRIME CONTRACTS)

THIS AGREEMENT, made the \_\_\_\_\_ day of \_\_\_\_\_ in the year of 20\_\_ by \_\_\_\_\_ and \_\_\_\_\_ between \_\_\_\_\_

hereinafter called the Party of the First Part and the State of North Carolina, through the \_\_\_\_\_ hereinafter called the Party of the Second Part.

### WITNESSETH:

That the Party of the First Part and the Party of the Second Part for the consideration herein named agree as follows:

1. Scope of Work: The Party of the First Part shall furnish and deliver all of the materials, and perform all of the work in the manner and form as provided by the following enumerated plans, specifications and documents, which are attached hereto and made a part thereof as if fully contained herein: advertisement; Instructions to Bidders; General Conditions; Supplementary General Conditions; specifications; accepted proposal; contract; performance bond; payment bond; power of attorney; workmen's compensation; public liability; property damage and builder's risk insurance certificates; approval of attorney general; certificate by the Office of State Budget and Management, and drawings, titled:

Maritime Education Center

Consisting of the following sheets:

Dated: \_\_\_\_\_ and the following addenda:

Addendum No. \_\_\_\_\_ Dated: \_\_\_\_\_ Addendum No. \_\_\_\_\_ Dated: \_\_\_\_\_

Addendum No. \_\_\_\_\_ Dated: \_\_\_\_\_ Addendum No. \_\_\_\_\_ Dated: \_\_\_\_\_

Addendum No. \_\_\_\_\_ Dated: \_\_\_\_\_ Addendum No. \_\_\_\_\_ Dated: \_\_\_\_\_

Addendum No. \_\_\_\_\_ Dated: \_\_\_\_\_ Addendum No. \_\_\_\_\_ Dated: \_\_\_\_\_

2. That the Party of the First Part shall commence work to be performed under this agreement on a date to be specified in a written order of the Party of the Second Part and shall fully complete all work hereunder within \_\_\_\_\_ consecutive calendar days from said date. For each day in excess thereof, liquidated damages shall be as stated in Supplementary General Conditions. The Party of the First Part, as one of the considerations for the awarding of this contract, shall furnish to the Party of the Second Part a construction schedule setting forth planned progress of the project broken down by

the various divisions or part of the work and by calendar days as outlined in Article 14 of the General Conditions of the Contract.

3. The Party of the Second Part hereby agrees to pay to the Party of the First Part for the faithful performance of this agreement, subject to additions and deductions as provided in the specifications or proposal, in lawful money of the United States as follows:

---

(\$ \_\_\_\_\_).

Summary of Contract Award:

4. In accordance with Article 31 and Article 32 of the General Conditions of the Contract, the Party of the Second Part shall review, and if approved, process the Party of the First Party's pay request within 30 days upon receipt from the Designer. The Party of the Second Part, after reviewing and approving said pay request, shall make payments to the Party of the First Part on the basis of a duly certified and approved estimate of work performed during the preceding calendar month by the First Party, less five percent (5%) of the amount of such estimate which is to be retained by the Second Party until all work has been performed strictly in accordance with this agreement and until such work has been accepted by the Second Party. The Second Party may elect to waive retainage requirements after 50 percent of the work has been satisfactorily completed on schedule as referred to in Article 31 of the General Conditions.

5. Upon submission by the First Party of evidence satisfactory to the Second Party that all payrolls, material bills and other costs incurred by the First Party in connection with the construction of the work have been paid in full, final payment on account of this agreement shall be made within thirty (30) days after the completion by the First Party of all work covered by this agreement and the acceptance of such work by the Second Party.

6. It is further mutually agreed between the parties hereto that if at any time after the execution of this agreement and the surety bonds hereto attached for its faithful performance, the Second Party shall deem the surety or sureties upon such bonds to be unsatisfactory, or if, for any reason, such bonds cease to be adequate to cover the performance of the work, the First Party shall, at its expense, within five (5) days after the receipt of notice from the Second Party so to do, furnish an additional bond or bonds in such form and amount, and with such surety or sureties as shall be satisfactory to the Second Party. In such event no further payment to the First Party shall be deemed to be due under this agreement until such new or additional security for the faithful performance of the work shall be furnished in manner and form satisfactory to the Second Party.

7. The Party of the First Part attest that it and all of its subcontractors have fully complied with all requirements of NCGS 64 Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

IN WITNESS WHEREOF, the Parties hereto have executed this agreement on the day and date first above written in \_\_\_\_\_ counterparts, each of which shall without proof or accounting for other counterparts, be deemed an original contract.

Witness:

\_\_\_\_\_  
Contractor: (Trade or Corporate Name)

\_\_\_\_\_  
(Proprietorship or Partnership)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Owner, Partner, or Corp. Pres. or Vice Pres. only)

Attest: (Corporation)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Corp. Sec. or Asst. Sec. only)

The State of North Carolina through

(CORPORATE SEAL)

\_\_\_\_\_  
(Agency, Department or Institution)

Witness:

\_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

## FORM OF PERFORMANCE BOND

Date of Contract: \_\_\_\_\_

Date of Execution: \_\_\_\_\_

Name of Principal  
(Contractor) \_\_\_\_\_

Name of Surety: \_\_\_\_\_

Name of Contracting  
Body: \_\_\_\_\_

Amount of Bond: \_\_\_\_\_

Project Maritime Education Center

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind, ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body, identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of said contract during the original term of said contract and any extensions thereof that may be granted by the contracting body, with or without notice to the surety, and during the life of any guaranty required under the contract, and shall also well and truly perform and fulfill all the undertakings, covenants, terms, conditions and agreements of any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in \_\_\_\_\_ counterparts.

Witness:

\_\_\_\_\_  
(Proprietorship or Partnership)

Attest: (Corporation)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Corp. Sec. or Asst. Sec. only)

(Corporate Seal)

Witness:

\_\_\_\_\_

Countersigned:

\_\_\_\_\_

\_\_\_\_\_  
(N.C. Licensed Resident Agent)

\_\_\_\_\_

\_\_\_\_\_  
Name and Address-Surety Agency

\_\_\_\_\_

\_\_\_\_\_  
Surety Company Name and N.C.  
Regional or Branch Office Address

\_\_\_\_\_  
Contractor: (Trade or Corporate Name)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Owner, Partner, or Corp. Pres. or Vice  
Pres. only)

\_\_\_\_\_  
(Surety Company)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Attorney in Fact)

(Surety Corporate Seal)

## FORM OF PAYMENT BOND

Date of Contract: \_\_\_\_\_

Date of Execution: \_\_\_\_\_

Name of Principal  
(Contractor) \_\_\_\_\_

Name of Surety: \_\_\_\_\_

Name of Contracting  
Body: \_\_\_\_\_

Amount of Bond: \_\_\_\_\_

Project Maritime Education Center

KNOW ALL MEN BY THESE PRESENTS, that we, the principal and surety above named, are held and firmly bound unto the above named contracting body, hereinafter called the contracting body, in the penal sum of the amount stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the principal entered into a certain contract with the contracting body identified as shown above and hereto attached:

NOW, THEREFORE, if the principal shall promptly make payment to all persons supplying labor/material in the prosecution of the work provided for in said contract, and any and all duly authorized modifications of said contract that may hereafter be made, notice of which modifications to the surety being hereby waived, then this obligation to be void; otherwise to remain in full force and virtue.

IN WITNESS WHEREOF, the above-bounden parties have executed this instrument under their several seals on the date indicated above, the name and corporate seal of each corporate party being hereto affixed and these presents duly signed by its undersigned representative, pursuant to authority of its governing body.

Executed in \_\_\_\_\_ counterparts.

Witness:

\_\_\_\_\_  
(Proprietorship or Partnership)

Attest: (Corporation)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Corp. Sec. or Asst. Sec.. only)

(Corporate Seal)

Witness:

\_\_\_\_\_

Countersigned:

\_\_\_\_\_

\_\_\_\_\_  
(N.C. Licensed Resident Agent)

\_\_\_\_\_

\_\_\_\_\_  
Name and Address-Surety Agency

\_\_\_\_\_

\_\_\_\_\_  
Surety Company Name and N.C.  
Regional or Branch Office Address

\_\_\_\_\_  
Contractor: (Trade or Corporate Name)

By: \_\_\_\_\_

Title \_\_\_\_\_  
(Owner, Partner, or Corp. Pres. or Vice  
Pres. only)

\_\_\_\_\_  
(Surety Company)

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Attorney in Fact)

(Surety Corporate Seal)

## Sheet for Attaching Power of Attorney



## Sheet for Attaching Insurance Certificates

## APPROVAL OF THE ATTORNEY GENERAL

**CERTIFICATION BY THE OFFICE OF STATE  
BUDGET AND MANAGEMENT**

Provision for the payment of money to fall due and payable by the

---

under this agreement has been provided for by allocation made and is available for the purpose of carrying out this agreement.

This \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_.

Signed \_\_\_\_\_  
Budget Officer



# FORM OF PROPOSAL

Maritime Education Center \_\_\_\_\_

Contract: Single Prime \_\_\_\_\_

Beaufort Heritage Foundation \_\_\_\_\_

Bidder: \_\_\_\_\_

SCO-ID # 23-26530-01A \_\_\_\_\_

Date: \_\_\_\_\_

The undersigned, as bidder, hereby declares that the only person or persons interested in this proposal as principal or principals is or are named herein and that no other person than herein mentioned has any interest in this proposal or in the contract to be entered into; that this proposal is made without connection with any other person, company or parties making a bid or proposal; and that it is in all respects fair and in good faith without collusion or fraud. The bidder further declares that he has examined the site of the work and the contract documents relative thereto and has read all special provisions furnished prior to the opening of bids; that he has satisfied himself relative to the work to be performed. The bidder further declares that he and his subcontractors have fully complied with NCGS 64, Article 2 in regards to E-Verification as required by Section 2.(c) of Session Law 2013-418, codified as N.C. Gen. Stat. § 143-129(j).

The Bidder proposes and agrees if this proposal is accepted to contract with the

State of North Carolina

in the form of contract specified below, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the construction of

the project including an approximately 8,700 sf of new construction and site work but is not limited to Demolition, Civil, Landscape, Plumbing, Mechanical, Electrical, Communications, Fire Alarm, Fire Suppression, and Architectural Improvements

in full and complete accordance with the plans, specifications and contract documents, to the full and entire satisfaction of the State of North Carolina, and the

Beaufort Heritage Foundation and Clark Nexsen

with a definite understanding that no money will be allowed for extra work except as set forth in the General Conditions and the contract documents, for the sum of:

## **SINGLE PRIME CONTRACT:**

Base Bid:

\_\_\_\_\_ Dollars(\$)

General Subcontractor:

Plumbing Subcontractor:

Mechanical Subcontractor:

Electrical Subcontractor:

GS143-128(d) requires all single prime bidders to identify their subcontractors for the above subdivisions of work. A contractor whose bid is accepted shall not substitute any person as subcontractor in the place of the subcontractor listed in the original bid, except (i) if the listed subcontractor's bid is later determined by the contractor to be non-responsible or non-responsive or the listed subcontractor refuses to enter into a contract for the complete performance of the bid work, or (ii) with the approval of the awarding authority for good cause shown by the contractor.

**ALTERNATES:**

Should any of the alternates as described in the contract documents be accepted, the amount written below shall be the amount to be "added to" or "deducted from" the base bid. (Strike out "Add" or "Deduct" as appropriate.)

**GENERAL CONTRACT SCOPE ALTERNATES:****Alternate No. 1:** Photovoltaic Module And Array

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. 2:** PV + 90-Minute Battery Backup For Panel "INV"

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. 2A:** PV + 90-Minute Battery Backup For Panel "MDP"

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. 3:** Concrete Benches

(Add) \_\_\_\_\_ Dollars (\$)

**Alternate No. 4:** Cedar Wood Siding

(Add) \_\_\_\_\_ Dollars (\$)

**UNIT PRICES**

Unit prices quoted and accepted shall apply throughout the life of the contract, except as otherwise specifically noted. Unit prices shall be applied, as appropriate, to compute the total value of changes in the base bid quantity of the work all in accordance with the contract documents.

**GENERAL CONTRACT:****No. 1 Removal of Unsatisfactory Soil and replacement with satisfactory soil material**

Base Contract Total: 500 cubic yards x \$\_\_\_\_\_/cubic yard = \$\_\_\_\_\_

**No. 2 Existing Foundation excavation and replacement with satisfactory soil material**

Base Contract Total: 500 cubic yards x \$\_\_\_\_\_/cubic yard = \$\_\_\_\_\_

The bidder further proposes and agrees hereby to commence work under this contract on a date to be specified in a written order of the designer and shall fully complete all work thereunder within the time specified in the Supplementary General Conditions Article 23. Applicable liquidated damages amount is also stated in the Supplementary General Conditions Article 23.

## **MINORITY BUSINESS PARTICIPATION REQUIREMENTS**

*Provide with the bid* - Under GS 143-128.2(c) the undersigned bidder shall identify **on its bid** (Identification of Minority Business Participation Form) the minority businesses that it will use on the project with the total dollar value of the bids that will be performed by the minority businesses. **Also** list the good faith efforts (Affidavit **A**) made to solicit minority participation in the bid effort.

**NOTE:** A contractor that performs all of the work with its own workforce may submit an Affidavit (**B**) to that effect in lieu of Affidavit (**A**) required above. The MB Participation Form must still be submitted even if there is zero participation.

*After the bid opening* - The Owner will consider all bids and alternates and determine the lowest responsible, responsive bidder. Upon notification of being the apparent low bidder, the bidder shall then file within 72 hours of the notification of being the apparent lowest bidder, the following:

An Affidavit (**C**) that includes a description of the portion of work to be executed by minority businesses, expressed as a percentage of the total contract price, which is equal to or more than the 10% goal established. This affidavit shall give rise to the presumption that the bidder has made the required good faith effort and Affidavit **D** is not necessary;

**\* OR \***

If less than the 10% goal, Affidavit (**D**) of its good faith effort to meet the goal shall be provided. The document must include evidence of all good faith efforts that were implemented, including any advertisements, solicitations and other specific actions demonstrating recruitment and selection of minority businesses for participation in the contract.

**Note:** Bidders must always submit **with their bid** the Identification of Minority Business Participation Form listing all MB contractors, vendors and suppliers that will be used. If there is no MB participation, then enter none or zero on the form. Affidavit A **or** Affidavit B, as applicable, also must be submitted with the bid. Failure to file a required affidavit or documentation with the bid or after being notified apparent low bidder is grounds for rejection of the bid.

## **Proposal Signature Page**

The undersigned further agrees that in the case of failure on his part to execute the said contract and the bonds within ten (10) consecutive calendar days after being given written notice of the award of contract, the certified check, cash or bid bond accompanying this bid shall be paid into the funds of the owner's account set aside for the project, as liquidated damages for such failure; otherwise the certified check, cash or bid bond accompanying this proposal shall be returned to the undersigned.

Respectfully submitted this day of \_\_\_\_\_

(Name of firm or corporation making bid)

WITNESS:

\_\_\_\_\_  
(Proprietorship or Partnership)

By: \_\_\_\_\_  
Signature

Name: \_\_\_\_\_  
Print or type

Title \_\_\_\_\_  
(Owner/Partner/Pres./V.Pres)

Address \_\_\_\_\_

ATTEST:

By: \_\_\_\_\_

Title: \_\_\_\_\_  
(Corp. Sec. or Asst. Sec. only)

License No. \_\_\_\_\_

Federal I.D. No. \_\_\_\_\_

Email Address: \_\_\_\_\_

(CORPORATE SEAL)

Addendum received and used in computing bid:

Addendum No. 1 \_\_\_\_\_ Addendum No. 3 \_\_\_\_\_ Addendum No. 5 \_\_\_\_\_ Addendum No. 6 \_\_\_\_\_

Addendum No. 2 \_\_\_\_\_ Addendum No. 4 \_\_\_\_\_ Addendum No. 6 \_\_\_\_\_ Addendum No. 7 \_\_\_\_\_



STATE OF NORTH CAROLINA  
COUNTY SALES AND USE TAX REPORT  
SUMMARY TOTALS AND CERTIFICATION

CONTRACTOR: \_\_\_\_\_

Page 1 of \_\_\_\_\_

PROJECT: \_\_\_\_\_

FOR PERIOD: \_\_\_\_\_

	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL FOR COUNTY OF:	TOTAL ALL COUNTIES
CONTRACTOR							
SUBCONTRACTOR(S)*							
COUNTY TOTAL							

\* Attach subcontractor(s) report(s)

\*\* Must balance with Detail Sheet(s)

I certify that the above figures do not include any tax paid on supplies, tools and equipment which were used to perform this contract and only includes those building materials, supplies, fixtures and equipment which actually became a part of or annexed to the building or structure. I certify that, to the best of my knowledge, the information provided here is true, correct, and complete.

Sworn to and subscribed before me,

This the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

\_\_\_\_\_  
Signed

\_\_\_\_\_  
Notary Public

My Commission Expires: \_\_\_\_\_

\_\_\_\_\_  
Print or Type Name of Above

Seal

NOTE:

This certified statement may be subject to audit.

# STATE OF NORTH CAROLINA SALES AND USE TAX REPORT DETAIL

CONTRACTOR: \_\_\_\_\_

Page 2 of       

SUBCONTRACTOR \_\_\_\_\_

FOR PERIOD: \_\_\_\_\_

PROJECT: \_\_\_\_\_

PURCHASE DATE	VENDOR NAME	INVOICE NUMBER	TYPE OF PROPERTY	INVOICE TOTAL	COUNTY TAX PAID	COUNTY OF SALE *
				\$	\$	
				TOTAL:	\$	

\* If this is an out-of-state vendor, the County of Sale should be the county to which the merchandise was shipped.

## SECTION 00 26 00 - SUBSTITUTION PROCEDURES DURING BIDDING

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Administrative and procedural requirements for substitutions during bidding process.
- B. Substitutions are only permitted during the bidding process. Substitutions are not permitted after contract award or during construction.

#### 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Bidder.
  - 1. Substitutions for Cause: Changes proposed by Bidder that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Will not be considered.

#### 1.3 SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form provided at the end of this section.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate Bidders, which will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    - e. Samples, where applicable or requested.

- f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project.
  - j. Detailed comparison of Bidder's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Bidder's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - m. Bidder's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Bidder of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Incorporation into the Bid Documents through Addendum.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

#### 1.4 QUALITY ASSURANCE

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

#### 1.5 PROCEDURES

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

### PART 2 - PRODUCTS

#### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause:

1. Conditions: Architect will consider Bidder's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
  - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  - b. Substitution request is fully documented and properly submitted.
  - c. Requested substitution will not adversely affect Bidder's construction schedule.
  - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
  - e. Requested substitution is compatible with other portions of the Work.
  - f. Requested substitution has been coordinated with other portions of the Work.
  - g. Requested substitution provides specified warranty.
  - h. If requested substitution involves more than one Bidder, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all Bidders involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION 00 26 00



## REQUEST FOR SUBSTITUTION DURING BIDDING

TO: Clark Nexsen  
421 North Harrington Street  
Raleigh, NC 27601

Attn: Matt Koonts

FROM: \_\_\_\_\_  
Name of manufacturer  
\_\_\_\_\_  
Street address  
\_\_\_\_\_  
City and state  
\_\_\_\_\_  
Phone number and name of person to contact

PROJECT: Maritime Education Center  
Beaufort, NC 28516  
Clark Nexsen Commission Number: 9041  
SCO ID Number: 23-26530-01A

1. Specification Section and Paragraph numbers of product specified \_\_\_\_\_
2. Proposed Substitute
  - A. Name and Model No.:
  - B. Description:
  - C. Attach applicable Submittals as required by the referenced Specification Section, i.e. Product Data, Materials List, Shop Drawings, Samples, Design Data, Test Reports, and Certificates. Attach Shop Drawings to the effect of the proposed substitution on adjacent components of the Work.
  - D. Insert Numbers of applicable reference standards:
  - E. Attach a color chart, if applicable.
  - F. Attach installation instructions.
3. Manufacturer's Reputation: Attach the following:
  - A. Evidence of reputation for prompt delivery.
  - B. Evidence of reputation for efficiency in servicing products.

4. Comparison: Attach an itemized comparison of the proposed substitution with product specified. Significant qualities may include elements such as size, weight, durability, performance, and visual effects.
5. Changes in Work: Attach data relating to changes required in other work to permit use of proposed substitution and changes required in construction schedule and overall contract time. Coordinate changes or modifications needed to other parts of the Work and to construction performed by the Owner and separate Contractors that will be necessary to accommodate the proposed substitution.
6. Cost Data: Attach accurate cost data on proposed substitution in comparison with product specified.
7. Previous Installation: Provide the following information on similar projects on which proposed substitution was used, list projects in the locale of the project primarily and then in other areas that best represent its application on this project:

<u>Name and Address of Project</u>	<u>Date of Installation</u>	<u>Name, Address, and Phone # of Architect</u>
--	---------------------------------	--

A.

B.

C.

D.

8. In making a request for substitution, the Manufacturer represents that:
  - A. He has examined the Drawings and Specifications and has determined that, to the best of his knowledge, the proposed substitution is appropriate for the use intended in the Drawings and Specifications.
  - B. He will provide the same or better warranty for substitution as for product or method specified.
  - C. The product is equal or better in quality and serviceability to the specified item.
9. In making a request for substitution, the Installer and Contractor each represents that:
  - A. He will coordinate the installation of accepted substitution into the Work, making such changes as may be required for the Work to be complete in all respects.



- B. He waives all claims for additional costs related to substitution which consequently become apparent.
- C. Cost data is complete and includes all related costs under his Contract but excludes costs under separate contracts and the Architect's redesign costs.
- D. The substitution meets the requirements of the Contract Documents, regardless of the evidence submitted or any review or independent investigation by the Owner or the Architect.

---

Name of Manufacturer and signature of Manufacturer's Rep.

---

Date

---

Name of Installer and signature of Installer's Rep.

---

Date

---

Name of Contractor and signature of Contractor's Rep.

---

Date



## SECTION 010400 - CONSTRUCTION SURVEYING

### PART 1 - GENERAL

#### 1.1 THE REQUIREMENT

- A. Provide construction surveying required in execution of the Project.
- B. Provide surveying to be used for documenting construction and for the preparation of Record Drawings.
- C. The CONTRACTOR shall retain the services of a Professional Land Surveyor licensed in the state in which the survey will be performed.

#### 1.2 SUBMITTALS

- A. Submit name and address of Professional Land Surveyor to be used on this project to the ENGINEER within 5 days of the Notice to Proceed.
- B. On request of the ENGINEER, submit documentation to verify accuracy of surveying work.
- C. Hard Copy of Construction Record
  - 1. Submit construction record of items required to be surveyed. The Drawing must be sealed by a Professional Land Surveyor as required in 1.1.C above.
- D. Electronic Documents
  - 1. An electronic file, compatible with the DXF (Drawing Exchange Format) format, containing survey points of both horizontal (X, Y) and vertical (tops and inverts, or Z) information shall be provided on a USB Drive or other acceptable method.

#### 1.3 DATUM

- A. The CONTRACTOR shall be responsible for correctly locating all lines and grades and for performing all measuring as required for the construction and completion of the Work from established reference points and information as shown on the Contract Drawings.
- B. All horizontal data shall be tied to State Plane Coordinate System in which the project is constructed, NAD 83. These drawings shall constitute the project record documents.
- C. All vertical data shall be tied to State Plane Coordinate System in which the project is constructed, NAVD 88 coordinates.

#### 1.4 SURVEY REFERENCE POINTS

- A. Only such primary control lines, monuments, and benchmarks (if any) will be set by the OWNER as the OWNER determines to be necessary to control establishment of the lines and grades required for completion of the Work. In general, these will consist of the primary horizontal and vertical control points indicated on the Contract Drawings. All other stakes or markers required to establish the lines and grades required for the completion of the Work shall be the responsibility of the CONTRACTOR.
- B. Primary control monuments set by the OWNER shall be carefully preserved by the CONTRACTOR. In case such monuments are destroyed or damaged, they shall be replaced at the CONTRACTOR's expense.

#### 1.5 SURVEYS FOR LAYOUT AND PERFORMANCE

- A. Surveying Requirements
  - 1. Perform all surveys for layout and performance of the Work, reduce the field notes, and make all calculations and drawings necessary to carry out such work. The CONTRACTOR shall check the relative positions of all monuments and benchmarks to be used and shall report any damaged or out-of-position monuments to the ENGINEER at once. The CONTRACTOR shall check such relative positions each time the CONTRACTOR uses such monument or benchmark.
- B. Equipment and Personnel
  - 1. The CONTRACTOR's instruments and other survey equipment shall be accurate, suitable for the surveys required in accordance with recognized professional standards, and in proper condition and adjustment at all times. Perform all surveys under the direct supervision of Professional Land Surveyor or ENGINEER currently licensed or registered in the state of which the project is constructed.
- C. Field Notes and Records
  - 1. Furnish the original pages of all survey records to the ENGINEER at intervals required by the ENGINEER. Furnish each field notebook to the ENGINEER when filled or completed.
- D. Use by the ENGINEER
  - 1. The ENGINEER may at any time use line and grade points and markers established by the CONTRACTOR. The CONTRACTOR's surveys are a part of the work and may be checked by the ENGINEER at any time. The CONTRACTOR shall be responsible for any lines, grades, or measurements which do not comply with specified or proper tolerances, or which are otherwise defective, and for any resultant defects in the work. The CONTRACTOR shall conduct resurveys or check surveys at no additional costs to correct errors indicated by review of the field notebooks or by check surveys performed by the ENGINEER.

#### 1.6 SURVEYING FOR PREPARATION OF RECORD DRAWINGS

- A. Requirement of record drawings shall be in accordance with the Authorities Having Jurisdiction.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements specifies requirements for installation examination.

### 3.2 SURVEYING ACCURACY AND TOLERANCES IN SETTING SURVEY STAKES

- A. Surveying Accuracy

- 1. Control

Control traverse field surveys and computations, including surveys of main control lines to determine horizontal and vertical alignment of major structure components, shall meet the accuracy requirements for 21 NCAC 56.1603 (1) Local Control Network Surveys (Class AA). Local control network surveys are traverse networks utilizing permanent points for the purpose of establishing local horizontal control networks for future use by local surveyors. For Class AA boundary surveys in North Carolina, the angular error of closure shall not exceed ten seconds times the square root of the number of angles turned. The ratio of precision shall not exceed an error of closure of one foot per 20,000 feet of perimeter of the parcel of land (1:20,000). When using positional accuracy standards for Class AA control and boundary surveys, neither axis of the 95 percent confidence level error ellipse for any control point or property corner shall exceed 0.05 feet or 0.015 meters plus 30 ppm measured relative to the position(s) of the horizontal control points used and referenced on the survey. Vertical control shall meet 21 NCAC 56.1605 (a)(1) Class A vertical control surveys in North Carolina.

- 2. Staking

- a. Staking for construction or equipment installations shall meet or exceed the accuracy requirements for 21 NCAC 56.1603 (2) Urban Land Surveys (Class A). Urban surveys include lands that normally lie within a town or city. For Class A boundary surveys in North Carolina, the angular error of closure shall not exceed 20 seconds times the square root of the number of angles turned. The ratio of precision shall not exceed an error of closure of one foot per 10,000 feet of perimeter of the parcel of land (1:10,000). When using positional accuracy standards for Class A control and boundary surveys, neither axis of the 95 percent confidence level error ellipse for any control point or property corner shall exceed 0.10 feet or 0.030 meters plus 50 ppm measured relative to the position(s) of the horizontal control points or property corners used and referenced on the survey.

- b.

- 3. Record Drawing Documentation

- a. Surveying to be used for the preparation of Record Documents shall meet the accuracy requirements for 21 NCAC 56.1603 (1) Local Control Network Surveys (Class AA). Local control network surveys are traverse networks utilizing permanent points for the purpose of establishing local horizontal control networks

for future use by local surveyors. For Class AA boundary surveys in North Carolina, the angular error of closure shall not exceed ten seconds times the square root of the number of angles turned. The ratio of precision shall not exceed an error of closure of one foot per 20,000 feet of perimeter of the parcel of land (1:20,000). When using positional accuracy standards for Class AA control and boundary surveys, neither axis of the 95 percent confidence level error ellipse for any control point or property corner shall exceed 0.05 feet or 0.015 meters plus 30 ppm measured relative to the position(s) of the horizontal control points used and referenced on the survey. Vertical control shall meet 21 NCAC 56.1605 (a)(1) Class A vertical control surveys in North Carolina Tolerances

4. The tolerances generally applicable in setting survey stakes shall be as set forth above. Such tolerances shall not supersede stricter tolerances required by the Contract Drawings or Specifications and shall not otherwise relieve the CONTRACTOR of responsibility for measurements in compliance therewith.

END OF SECTION 010400

## SECTION 011000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Owner-furnished/Contractor-installed (OFICI) products.
4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.

- B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

#### 1.3 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and material schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

#### 1.4 PROJECT INFORMATION

- A. Project Identification: **Maritime Education Center, Maritime Heritage Foundation**

1. Project Location: **293 W Beaufort Rd  
Beaufort, North Carolina 28516**

B. Owner: **Maritime Heritage Foundation**

1. Owner's Representative: **Bucky Oliver**  
Bucky Oliver  
Maritime Heritage Foundation  
PO Box 685  
Beaufort, NC 28516

C. Architect and FP&MEP Engineer: **Clark Nexsen**

1. Architect's Representative: **Don Kranbuehl**  
Don Kranbuehl, FAIA  
Principal  
Clark Nexsen  
421 North Harrington Street  
Raleigh, NC 27603

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

1. **Civil: Withers Ravenel**

219 Station Rd #101  
Wilmington, NC 28405  
910.256.9277

2. **Landscape: Stewart**

223 S West St Suite 1100  
Raleigh, NC 27603  
919.380.8750

3. **Structural Engineer: Lynch Mykins**

301 N. West Street, Suite 105  
Raleigh, NC 27603  
919.809.8946

4. **Security: Protus 3**

5540 Centerview Drive, Suite 214  
Raleigh, NC 27606  
919.834.8584



5. **Cost and Constructability: CPE**

120 N. Candler St. Suite 1  
Decatur, GA 30030  
404.431.9343

E. Other Owner Consultants: Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:

1. Special Inspections: TBD
  - a. Representative: TBD
  - b. Scope of Service: Special Inspections

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

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.5 **WORK COVERED BY CONTRACT DOCUMENTS**

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

1. The project consists of the construction of a new Maritime Education Center (MEC) for the Maritime Heritage Foundation which includes two major parts:
  - a. Site Work: site grading, the "the Great Lawn" space for the museum campus, an entrance drive, parking lots, sidewalks, a drop off loop for MEC, and infrastructure for MEC and future Maritime Museum.
  - b. Building Work – classroom/office/ticketing building of approximately 8700 sf of enclosed space.
2. Site Work includes the main open Lawn landscape space. It is envisioned as the "Heart of Gallant's Channel." It is designed to hold large events, concerts and festivals. Site work includes an entrance drive off of West Beaufort Road Extension, all of the parking lots as shown for the MEC, sidewalks, drop off loop, landscaping, rough grading and clearing of the entire site, and the necessary infrastructure including water, sewer, and storm drains. The site is designed to bring the grades for the first floor of the MEC and future museum to be at least 4'-6' above the hundred year flood elevation level.
3. The MEC Building will be Construction Type IIIB and is composed of two structures: a one story and story structure. The two structures are connected by a large covered outdoor porch that will be used for outdoor events and faces the water and the museum Great Lawn. It will have a sprinkler system. The one-story structure houses the ticketing/visitor center area with bathrooms for ferry visitors and a ferry staff office. The

two-story structure contains on the first floor a large multi-purpose classroom that can be subdivided with a folding partition, a layout kitchen to allow for layout of catering, storage space and a conference room. It also contains restrooms with showers that have exterior access for the nearby sailing school. On the upper floor, there are open and enclosed offices, a conference room, mechanical space, and storage rooms. The structural system will be a cmu loadbearing and steel structure with reinforced cmu walls for a lateral system. Walls will primarily be metal stud with rigid insulation and air barriers with fiber-cement and wood rainscreen siding. The roof system, like the exterior siding, will need to be resilient and long lasting for the coastal environment and withstand 144 MPH winds. The roof will be a standing seam metal roof. Openings will be aluminum storefront and curtainwall with low E, UV filtering glass and will need to withstand 144 mph winds. Lighting will primarily be LED lighting. Interior finishes will be durable, long lasting finishes for a coastal environment and will be primarily sealed and polished concrete, porcelain tile, and some carpet for acoustics.

4. The mechanical heating, cooling, and ventilation system will be a heat recovery Variable Refrigerant Volume (VRV) system. The total system capacity is approximately 32 ton of cooling. The VRF system will consist of an air source, heat recovery, outdoor condensing unit, various indoor terminal units for space control, and outdoor air processing units for ventilation.
5. Utilities: Domestic water and fire protection lines will be serviced from the existing water main along West Beaufort Road Extension. Water meters and backflow preventers are provided. Sanitary sewer service is provided via connection to the existing force main along West Beaufort Road Extension. Sewer cleanouts will be fed via gravity flow from the buildings to the new pump station.
6. Stormwater: Stormwater for the site will be regulated by the State's Department of Energy, Mineral, and Land Resources (NC DEMLR) Coastal Storm Water Permitting program. The stormwater run off from improved areas will be directed to designed grass swales and overland flow. The project is considered "low density" with less than 24% impervious area and consequently there are no Stormwater Control measures (SCM) for the project. There are areas of permeable pavement and bioretention areas within the project for reducing impacts of stormwater and for educational purposes for visitors.
7. Earthwork: The project site is designed as a fill site where fill is brought in from offsite to set the buildings at or above required flood elevations and to add d

B. Type of Contract:

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

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

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

1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.

2. Provide for delivery of Owner-furnished products to Project site.
3. Upon delivery, inspect, with Contractor present, delivered items.
  - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
4. Obtain manufacturer's inspections, service, and warranties.
5. Inform Contractor of earliest available delivery date for Owner-furnished products.

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

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

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

1. Owner Furniture

## 1.7 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  1. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

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

## 1.8 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Limit work to between 7 a.m. to 6 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
  - 1. Weekend Hours: At no cost to owner, weekends are owner approved with written notice on case by case basis
  - 2. Early Morning Hours: At no cost to owner, early mornings are owner approved with written notice on case by case basis
  - 3. Work in Existing Building: NA
  - 4. Hours for Utility Shutdowns: 5 days written notice
  - 5. Hours for Core Drilling : 5 days written notice.
  - 6. Blackout days: NA
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than two days in advance of proposed utility interruptions.
  - 2. Obtain Architect's written permission before proceeding with utility interruptions.
- D. Eating, Drinking, Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.
- E. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- F. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
  - 1. Maintain list of approved screened personnel with Owner's representative.

## 1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
  3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
  4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.
  3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000



## SECTION 012100 - ALLOWANCES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
- B. Types of allowances include the following:
  - 1. Unit-cost allowances.
  - 2. Quantity allowances.
- C. Related Requirements:
  - 1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.
  - 2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

#### 1.3 DEFINITIONS

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

#### 1.4 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
  - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.



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

## 1.9 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, required maintenance materials, and similar margins.
  1. Include installation costs in purchase amount only where indicated as part of the allowance.
  2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
  3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
  4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs due to a change in the scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
  1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
  2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

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

### 3.3 SCHEDULE OF QUANTITY ALLOWANCES

- A. Allowance No. 1: Quantity Allowance: Include 500 cu. yd. of unsatisfactory soil excavation and disposal off-site and replacement with satisfactory soil material from off-site, as specified in Section 312300 "Earth Moving."
  - 1. Coordinate quantity allowance adjustment with unit-price requirements in Section 012200 "Unit Prices."
- B. Allowance No. 2: Quantity Allowance: Include 500 cu. yd. of existing concrete foundation removal and replacement with satisfactory soil material, as specified in Section 311505 "Excavation, Backfill and Compaction."
  - 1. Coordinate quantity allowance adjustment with unit-price requirements in Section 012200 "Unit Prices."

END OF SECTION 012100

## SECTION 012200 - UNIT PRICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
  - 1. Section 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
  - 2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
  - 3. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

#### 1.3 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

#### 1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 311505 "Excavation Backfill and Compaction."
  2. Unit of Measurement: **cubic yard** of soil excavated, based on in-place surveys of volume before and after removal.
  3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."
- B. Unit Price No. 2: Existing Foundation excavation and replacement with satisfactory soil material.
1. Description: Existing Foundation excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 311505 "Excavation Backfill and Compaction."
  2. Unit of Measurement: **cubic yard** of rock excavated, based on survey of in-place surveys volume of before and after removal.
  3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."

END OF SECTION 012200

## SECTION 012300 - ALTERNATES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

#### 1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

#### 1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Alternate No. 1: PV Panel System

1. Base Bid: No PV panel system. GDS, inverter, and lights with integral batteries.
2. Alternate: PV Panel system as indicated on Drawing AE121 and as specified in Section "PHOTOVOLTAIC COLLECTORS (ADD ALTERNATE NO. 1, NO. 2 & NO. 2A)" specification 263100.

B. Alternate No. 2: PV + 90-MINUTE BATTERY BACKUP FOR PANEL "INV" (ALTERNATE NO. 2)

1. Base Bid: No PV Panel. GDS, inverter, and lights with integral batteries.
2. Alternate: Integrated Battery system that stores solar energy for back up protection as shown on electrical drawings and specified in section "PHOTOVOLTAIC COLLECTORS (ADD ALTERNATE NO. 1, NO. 2 & NO. 2A)" specification 263100

C. Alternate No. 2A: PV + 90-MINUTE BATTERY BACKUP FOR PANEL "INV" (ALTERNATE NO. 2)

1. Base Bid: No PV Panel. GDS, inverter, and lights with integral batteries.
2. Alternate: Integrated Battery system that stores solar energy for back up protection as shown on electrical drawings and specified in section "PHOTOVOLTAIC COLLECTORS (ADD ALTERNATE NO. 1, NO. 2 & NO. 2A)" specification 263100

D. Alternate No. 3: Concrete Benches

1. Base Bid: No concrete benches along Great Lawn
2. Alternate: Reinforced Concrete benches as shown on drawings L3.01 and L3.02 and L4.00.

E. Alternate No. 4: Cedar Wood Siding

1. Base Bid: Fiber Cement Painted Siding.
2. Alternate: 8" Cedar wood siding planks sealed as shown on drawings and specified in "Exterior Finish Carpentry" 062013.

F. Alternate No. 5: Add Gravel at Overflow Lots

1. Base Bid: Fine grading at 2 overflow lots.
2. Alternate: Add gravel at 2 overflow lots.

G. Alternate No. 6: Add grading in the area North of West Beaufort Road Extension

1. Base Bid: Grading to remain as is.
  2. Alternate: Add grading to the north side of West Beaufort Road Extension as shown on the civil plans.
- H. Alternate No. 7: Add Grading Beyond Fire Access Road & Overflow Parking to the West
1. Base Bid: No grading to occur past the fire access road/overflow parking on the west side of the site.
  2. Alternate: Grading beyond what is required as noted on the civil drawings in support of the fire access road and overflow parking to the west.
- I. Alternate No. 8: Add sf of enhanced landscape.
1. Base Bid: No landscaping within area unless required in area north of the new road and east of Bonehenge.
  2. Alternate: Add 23,296 sf of enhanced landscape in area north of the new road and east of Bonehenge.
- J. Alternate No. 9: Curb Alternate
1. Base bid: Standard curb as shown on landscape drawings.
  2. Alternate: Add 2-foot wide cobble stone detail in lieu of standard curb.
- K. Alternate No. 10: Pervious Concrete vs pervious pavers
1. Base Bid: Pervious Concrete as shown on landscape plans.
  2. Alternate: Add pervious pavers in lieu of pervious concrete.
- L. Alternate No. 11: Operable partition
1. Base Bid: No operable partition, storefront or structural beam.
  2. Alternate: Provide operable partition, structural beam and storefront.

END OF SECTION 012300





## SECTION 012500 - SUBSTITUTION PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
  - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
  - 2. Section 012100 "Allowances" for products selected under an allowance.
  - 3. Section 012300 "Alternates" for products selected under an alternate.
  - 4. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
  - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
  - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

#### 1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Substitution Request Form: Use form acceptable to Architect.
  - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

- a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
  - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
  - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
  - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  - e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Cost information, including a proposal of change, if any, in the Contract Sum.
  - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
  - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
  - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 10 days prior to time required for preparation and review of related submittals.

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

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

- B. Substitutions for Convenience: Not allowed

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500



## SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
  - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
  - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

#### 1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

#### 1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Within 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use **forms acceptable to Architect**.

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

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

## 1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

## 1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

## 1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600





## SECTION 012900 – PAYMENT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
  - 2. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
  - 3. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 4. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

#### 1.3 DEFINITIONS

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

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:

- a. Project name and location.
  - b. Owner's name.
  - c. Owner's Project number.
  - d. Name of Architect.
  - e. Architect's Project number.
  - f. Contractor's name and address.
  - g. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
  - a. Related Specification Section or division.
  - b. Description of the Work.
  - c. Name of subcontractor.
  - d. Name of manufacturer or fabricator.
  - e. Name of supplier.
  - f. Change Orders (numbers) that affect value.
  - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
    - 1) Labor.
    - 2) Materials.
    - 3) Equipment.
4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of one percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between items stored on-site and items stored off-site.
6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.

11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling one percent of the Contract Sum and subcontract amount.
12. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

#### 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Payment Application Times: Submit Application for Payment to Architect by the 25<sup>th</sup> day of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
  1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to **Architect** by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
  5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
  5. Products list (preliminary if not final).
  6. Sustainable design action plans, including preliminary project materials cost data.
  7. Schedule of unit prices.
  8. Submittal schedule (preliminary if not final).
  9. List of Contractor's staff assignments.
  10. List of Contractor's principal consultants.
  11. Copies of building permits.

12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  13. Initial progress report.
  14. Report of preconstruction conference.
  15. Certificates of insurance and insurance policies.
  16. Performance and payment bonds.
  17. Data needed to acquire Owner's insurance.
- J. Application for Payment at Final Acceptance: After Architect issues the Certificate of Final Acceptance, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as complete.
1. Include documentation supporting claim that the Work is complete and a statement showing an accounting of changes to the Contract Sum.
    - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
  2. This application shall reflect the notice of Final Acceptance issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Certification of completion of final punch list items.
  3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  4. Updated final statement, accounting for final changes to the Contract Sum.
  5. AIA Document G706.
  6. AIA Document G706A.
  7. AIA Document G707.
  8. Evidence that claims have been settled.
  9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Final Acceptance or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
  10. Final liquidated damages settlement statement.
  11. Proof that taxes, fees, and similar obligations are paid.
  12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900



## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. RFIs.
  - 4. Digital project management procedures.
  - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
  - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
  - 4. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

#### 1.3 DEFINITIONS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  2. Number and title of related Specification Section(s) covered by subcontract.
  3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in Project meeting room, in temporary field office, and in prominent location in built facility. Keep list current at all times.

#### 1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
  2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
  2. Preparation of the schedule of values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Progress meetings.
  6. Preinstallation conferences.
  7. Project closeout activities.
  8. Startup and adjustment of systems.



## 1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.
    - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  2. Plenum Space: Indicate subframing for support of ceiling, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
  3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    - c. Fire-rated enclosures around ductwork.
  7. Electrical Work: Show the following:
    - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
    - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
  8. Fire-Protection System: Show the following:
    - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
  9. Review: Architect will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
  10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
  2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
  3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
  4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
  5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
  6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.

7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
- D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Submittal Format: Submit or post coordination drawing files using PDF format.
  2. BIM File Incorporation: Develop and incorporate drawing files into BIM 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 Architect.
  3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    - b. Digital Data Software Program: Drawings are available in Revit.
    - c. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual.

#### 1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Owner name.
  3. Owner's Project number.
  4. Name of Architect.
  5. Architect's Project number.
  6. Date.
  7. Name of Contractor.
  8. RFI number, numbered sequentially.
  9. RFI subject.

10. Specification Section number and title and related paragraphs, as appropriate.
  11. Drawing number and detail references, as appropriate.
  12. Field dimensions and conditions, as appropriate.
  13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  14. Contractor's signature.
  15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow **seven** days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 5 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
  2. Name and address of Contractor.

3. Name and address of Architect.
  4. RFI number, including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within three days if Contractor disagrees with response.

#### 1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
  2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
  3. Digital Drawing Software Program: Contract Drawings are available in Revit.
  4. Contractor shall execute a data licensing agreement in the form of Agreement included in Project Manual.
    - a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of Agreement included in this Project Manual.
- B. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
  2. Name file with submittal number or other unique identifier, including revision identifier.
  3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

#### 1.9 PROJECT MEETINGS

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

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Responsibilities and personnel assignments.
    - b. Tentative construction schedule.
    - c. Phasing.
    - d. Critical work sequencing and long lead items.
    - e. Designation of key personnel and their duties.
    - f. Lines of communications.
    - g. Use of web-based Project software.
    - h. Procedures for processing field decisions and Change Orders.
    - i. Procedures for RFIs.
    - j. Procedures for testing and inspecting.
    - k. Procedures for processing Applications for Payment.
    - l. Distribution of the Contract Documents.
    - m. Submittal procedures.
    - n. Sustainable design requirements.
    - o. Preparation of Record Documents.
    - p. Use of the premises.
    - q. Work restrictions.
    - r. Working hours.
    - s. Owner's occupancy requirements.
    - t. Responsibility for temporary facilities and controls.
    - u. Procedures for moisture and mold control.
    - v. Procedures for disruptions and shutdowns.
    - w. Construction waste management and recycling.
    - x. Parking availability.
    - y. Office, work, and storage areas.
    - z. Equipment deliveries and priorities.
    - aa. First aid.
    - bb. Security.
    - cc. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Sustainable Design Requirements Coordination Conference: Owner will schedule and conduct a sustainable design coordination conference before starting construction, at a time convenient to Owner, Architect, and Contractor.
1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect meeting sustainable design requirements, including the following:
    - a. Sustainable design Project checklist.
    - b. General requirements for sustainable design-related procurement and documentation.
    - c. Project closeout requirements and sustainable design certification procedures.
    - d. Role of sustainable design coordinator.
    - e. Construction waste management.
    - f. Construction operations and sustainable design requirements and restrictions.
  3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Sustainable design requirements.
    - i. Review of mockups.
    - j. Possible conflicts.
    - k. Compatibility requirements.
    - l. Time schedules.

- m. Weather limitations.
    - n. Manufacturer's written instructions.
    - o. Warranty requirements.
    - p. Compatibility of materials.
    - q. Acceptability of substrates.
    - r. Temporary facilities and controls.
    - s. Space and access limitations.
    - t. Regulations of authorities having jurisdiction.
    - u. Testing and inspecting requirements.
    - v. Installation procedures.
    - w. Coordination with other work.
    - x. Required performance results.
    - y. Protection of adjacent work.
    - z. Protection of construction and personnel.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  - 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- E. Project Closeout Conference: Schedule and conduct project closeout conference, at a time convenient to Owner and Architect, but no later than **90** days prior to the scheduled date of Final Acceptance.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of Record Documents.
    - b. Procedures required prior to inspection for Final Acceptance and for final inspection for acceptance.
    - c. Procedures for completing and archiving web-based Project software site data files.
    - d. Submittal of written warranties.
    - e. Requirements for completing sustainable design documentation.
    - f. Requirements for preparing operations and maintenance data.
    - g. Requirements for delivery of material samples, attic stock, and spare parts.
    - h. Requirements for demonstration and training.
    - i. Preparation of Contractor's punch list.



- j. Procedures for processing Applications for Payment at Final Acceptance and for final payment.
    - k. Submittal procedures.
    - l. Coordination of separate contracts.
    - m. Owner's partial occupancy requirements.
    - n. Installation of Owner's furniture, fixtures, and equipment.
    - o. Responsibility for removing temporary facilities and controls.
  - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- F. Progress Meetings: Conduct progress meetings biweekly - every two weeks.
- 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project or as recommended by owner or architect.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Resolution of BIM component conflicts.
      - 4) Status of submittals.
      - 5) Status of sustainable design documentation.
      - 6) Deliveries.
      - 7) Off-site fabrication.
      - 8) Access.
      - 9) Site use.
      - 10) Temporary facilities and controls.
      - 11) Progress cleaning.
      - 12) Quality and work standards.
      - 13) Status of correction of deficient items.
      - 14) Field observations.
      - 15) Status of RFIs.
      - 16) Status of Proposal Requests.

- 17) Pending changes.
    - 18) Status of Change Orders.
    - 19) Pending claims and disputes.
    - 20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
  - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- G. Coordination Meetings: Conduct Project coordination meetings at **weekly** intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each contractor present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Resolution of BIM component conflicts.
      - 4) Status of submittals.
      - 5) Deliveries.
      - 6) Off-site fabrication.
      - 7) Access.
      - 8) Site use.
      - 9) Temporary facilities and controls.
      - 10) Work hours.
      - 11) Hazards and risks.

- 12) Progress cleaning.
  - 13) Quality and work standards.
  - 14) Status of RFIs.
  - 15) Proposal Requests.
  - 16) Change Orders.
  - 17) Pending changes.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100



## SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Startup construction schedule.
  - 2. Contractor's Construction Schedule.
  - 3. Construction schedule updating reports.
  - 4. Daily construction reports.
  - 5. Material location reports.
  - 6. Site condition reports.
  - 7. Unusual event reports.
- B. Related Requirements:
  - 1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
  - 2. Section 014000 "Quality Requirements" for schedule of tests and inspections.
  - 3. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

#### 1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. PDF file.
- B. Startup construction schedule.
  - 1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
  - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

#### 1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist with three years experience of similar size and complexity project in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures

related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including work stages and interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

#### 1.6 COORDINATION

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

#### 1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
  1. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Time Frame: Extend schedule from date established for Notice of Award to date of Final Completion.
  1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.

2. Indicate start and completion dates for the following as applicable:
    - a. Securing of approvals and permits required for performance of the Work.
    - b. Temporary facilities.
    - c. Construction of mock-ups, prototypes and samples.
    - d. Owner interfaces and furnishing of items.
    - e. Interfaces with Separate Contracts.
    - f. Regulatory agency approvals.
    - g. Punch list.
  3. Procurement Activities: Include procurement process activities for long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
  6. Commissioning Time: Include no fewer than 15 days for commissioning.
  7. Final Acceptance: Indicate completion in advance of date established for Final Acceptance, and allow time for Architect's administrative procedures necessary for certification of Final Acceptance.
  8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  3. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Limitations of continued occupancies.
    - c. Uninterruptible services.
    - d. Partial occupancy before Final Acceptance.
    - e. Use-of-premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
  4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.



- b. Submittals.
  - c. Purchases.
  - d. Mockups.
  - e. Fabrication.
  - f. Sample testing.
  - g. Deliveries.
  - h. Installation.
  - i. Tests and inspections.
  - j. Adjusting.
  - k. Curing.
  - l. Building flush-out.
  - m. Startup and placement into final use and operation.
  - n. Commissioning.
- 5. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
  - a. Structural completion.
  - b. Temporary enclosure and space conditioning.
  - c. Permanent space enclosure.
  - d. Completion of mechanical installation.
  - e. Completion of electrical installation.
  - f. Final Acceptance.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Final Acceptance, and Final Completion, and the following interim milestones:
  - 1. Temporary enclosure and space conditioning.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered Requests for Information.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
  - 5. Pending modifications affecting the Work and the Contract Time.
- G. Contractor's Construction Schedule Updating: **At monthly intervals**, update schedule to reflect actual construction progress and activities. **Issue schedule one week** before each regularly scheduled progress meeting.
  - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
  - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.

3. As the Work progresses, indicate Final Completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
  1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

## 1.8 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
  1. List of subcontractors at Project site.
  2. List of separate contractors at Project site.
  3. Approximate count of personnel at Project site.
  4. Equipment at Project site.
  5. Material deliveries.
  6. High and low temperatures and general weather conditions, including presence of rain or snow.
  7. Testing and inspection.
  8. Accidents.
  9. Meetings and significant decisions.
  10. Unusual events.
  11. Stoppages, delays, shortages, and losses.
  12. Meter readings and similar recordings.
  13. Emergency procedures.
  14. Orders and requests of authorities having jurisdiction.
  15. Change Orders received and implemented.
  16. Construction Change Directives received and implemented.
  17. Services connected and disconnected.
  18. Equipment or system tests and startups.
  19. Partial completions and occupancies.
  20. Final Acceptance authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on

and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
  2. Material stored prior to previous report and since removed from storage and installed.
  3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200



## SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Concealed Work photographs.
  - 3. Periodic construction photographs.
  - 4. Final Completion construction photographs.
- B. Related Requirements:
  - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
  - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
  - 3. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
  - 1. Identification: Provide the following information with each image description in file metadata tag:
    - a. Name of Project.
    - b. Name and contact information for photographer.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Date photograph was taken.
    - f. Description of location, vantage point, and direction.

- g. Unique sequential identifier keyed to accompanying key plan.

#### 1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time from camera.
- D. File Names: Name media files with date and sequential numbering suffix.

#### 1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  - 1. Flag construction limits before taking construction photographs.
  - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
  - 1. Underground utilities.
  - 2. Underslab services.
  - 3. Piping.
  - 4. Electrical conduit.
  - 5. Waterproofing and weather-resistant barriers.
- E. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

- F. Final Completion Construction Photographs: Take 20 photographs after date of Final Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233





## SECTION 013300 - SUBMITTAL PROCEDURES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

#### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

### 1.3 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
  4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal Category: Action; informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.
    - f. Scheduled date for Architect's final release or approval.
    - g. Scheduled dates for purchasing.
    - h. Scheduled date of fabrication.
    - i. Scheduled dates for installation.
    - j. Activity or event number.

### 1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
  2. Date.
  3. Name of Architect.
  4. Name of Construction Manager.
  5. Name of Contractor.
  6. Name of firm or entity that prepared submittal.
  7. Names of subcontractor, manufacturer, and supplier.
  8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
  9. Category and type of submittal.
  10. Submittal purpose and description.

11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
  12. Drawing number and detail references, as appropriate.
  13. Indication of full or partial submittal.
  14. Location(s) where product is to be installed, as appropriate.
  15. Other necessary identification.
  16. Remarks.
  17. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.

## 1.5 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
    - a. Architect, will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
  5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## 1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.

- e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  - 4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams that show factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
- 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
- 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
  - 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
    - a. Project name and submittal number.
    - b. Generic description of Sample.
    - c. Product name and name of manufacturer.
    - d. Sample source.
    - e. Number and title of applicable Specification Section.
    - f. Specification paragraph number and generic name of each item.
  - 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.

4. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
  - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
  - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
  - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.
    - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.

- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
  - 1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
  - 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
  - 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
  - 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
  - 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
  - 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
  - 1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
  - 2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
  - 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
  - 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
  - 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - a. Name of evaluation organization.
  - b. Date of evaluation.
  - c. Time period when report is in effect.
  - d. Product and manufacturers' names.
  - e. Description of product.
  - f. Test procedures and results.
  - g. Limitations of use.

#### 1.7 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM Incorporation: Incorporate delegated design drawing and data files into BIM established for Project.
  1. Prepare delegated design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

#### 1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.



1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

#### 1.9 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return.
  1. PDF Submittals: Architect will indicate, via markup on each submittal, the appropriate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect will discard submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300



## SECTION 014000 - QUALITY REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
  - 1. Section 012100 "Allowances" for testing and inspection allowances.

#### 1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.
- B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. In-Place Mockups: Physical assemblies of portions of the work constructed on-site in their actual final location as part of permanent construction . Mockups are not Samples.
  - 1. Mockups are used for one or more of the following:
    - a. Verify selections made under Sample submittals.
    - b. Demonstrate aesthetic effects.
    - c. Demonstrate the qualities of products and workmanship.
    - d. Demonstrate successful installation of interfaces between components and systems.
    - e. Perform preconstruction testing to determine system performance.
  - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agent Mockups constructed on-site in their actual final location as part of permanent construction cy."
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

#### 1.4 DELEGATED DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

#### 1.5 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

#### 1.6 ACTION SUBMITTALS

- A. Mockup Shop Drawings:
  - 1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
  - 2. Indicate manufacturer and model number of individual components.
  - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

#### 1.7 INFORMATIONAL SUBMITTALS

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

- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  - 2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

#### 1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  - 1. Project quality-control manager may also serve as Project superintendent.

- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  - 1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
  - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
  - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

## 1.9 REPORTS AND DOCUMENTS

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

- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement of whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement of whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.

#### 1.10 QUALITY ASSURANCE

- A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing



engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
  - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following Contractor's responsibilities, including the following:
  - 1. Provide test specimens representative of proposed products and construction.
  - 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
  - 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
  - 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
  - 5. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.
  - 6. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated – 6' wide by 6' tall with a corner condition.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.
  - a. Allow seven days for initial review and each re-review of each mockup.
7. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

#### 1.11 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
  1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.

7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
  1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payment.
  1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
  2. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### 1.12 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached to this Section, 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, Commissioning Authority, 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 and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Final Acceptance, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  - 1. Date test or inspection was conducted.
  - 2. Description of the Work tested or inspected.
  - 3. Date test or inspection results were transmitted to Architect.
  - 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, and authorities' having jurisdiction reference during normal working hours.
  - 1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
  - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000



## SECTION 014200 - REFERENCES

### PART 1 - GENERAL

#### 1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

#### 1.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

### 1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. AABC - Associated Air Balance Council; [www.aabc.com](http://www.aabc.com).
  2. AAMA - American Architectural Manufacturers Association; (See FGIA).
  3. AAPFCO - Association of American Plant Food Control Officials; [www.aapfco.org](http://www.aapfco.org).
  4. AASHTO - American Association of State Highway and Transportation Officials; [www.transportation.org](http://www.transportation.org).
  5. AATCC - American Association of Textile Chemists and Colorists; [www.aatcc.org](http://www.aatcc.org).
  6. ABMA - American Bearing Manufacturers Association; [www.americanbearings.org](http://www.americanbearings.org).
  7. ABMA - American Boiler Manufacturers Association; [www.abma.com](http://www.abma.com).
  8. ACI - American Concrete Institute; (Formerly: ACI International); [www.concrete.org](http://www.concrete.org).
  9. ACPA - American Concrete Pipe Association; [www.concrete-pipe.org](http://www.concrete-pipe.org).
  10. AEIC - Association of Edison Illuminating Companies, Inc. (The); [www.aeic.org](http://www.aeic.org).
  11. AF&PA - American Forest & Paper Association; [www.afandpa.org](http://www.afandpa.org).
  12. AGA - American Gas Association; [www.aga.org](http://www.aga.org).
  13. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); [www.ahrinet.org](http://www.ahrinet.org).
  14. AI - Asphalt Institute; [www.asphaltinstitute.org](http://www.asphaltinstitute.org).
  15. AIA - American Institute of Architects (The); [www.aia.org](http://www.aia.org).
  16. AISC - American Institute of Steel Construction; [www.aisc.org](http://www.aisc.org).
  17. AISI - American Iron and Steel Institute; [www.steel.org](http://www.steel.org).
  18. AMCA - Air Movement and Control Association International, Inc.; [www.amca.org](http://www.amca.org).
  19. ANSI - American National Standards Institute; [www.ansi.org](http://www.ansi.org).
  20. AOSA - Association of Official Seed Analysts, Inc.; [www.aosaseed.com](http://www.aosaseed.com).
  21. APA - APA - The Engineered Wood Association; [www.apawood.org](http://www.apawood.org).
  22. APA - Architectural Precast Association; [www.archprecast.org](http://www.archprecast.org).
  23. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
  24. ASCE - American Society of Civil Engineers; [www.asce.org](http://www.asce.org).



25. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
26. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; [www.ashrae.org](http://www.ashrae.org).
27. ASME - ASME International; (American Society of Mechanical Engineers); [www.asme.org](http://www.asme.org).
28. ASSE - American Society of Sanitary Engineering; [www.asse-plumbing.org](http://www.asse-plumbing.org).
29. ASSP - American Society of Safety Professionals (The); [www.assp.org](http://www.assp.org).
30. ASTM - ASTM International; [www.astm.org](http://www.astm.org).
31. AVIXA - Audiovisual and Integrated Experience Association; (Formerly: Infocomm International); [www.avixa.org](http://www.avixa.org).
32. .
33. AWI - Architectural Woodwork Institute; [www.awinet.org](http://www.awinet.org).
34. AWMAC - Architectural Woodwork Manufacturers Association of Canada; [www.awmac.com](http://www.awmac.com).
35. AWWPA - American Wood Protection Association; [www.awpa.com](http://www.awpa.com).
36. AWS - American Welding Society; [www.aws.org](http://www.aws.org).
37. BHMA - Builders Hardware Manufacturers Association; [www.buildershardware.com](http://www.buildershardware.com).
38. BIA - Brick Industry Association (The); [www.gobrick.com](http://www.gobrick.com).
39. BICSI - BICSI, Inc.; [www.bicsi.org](http://www.bicsi.org).
40. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); [www.bifma.org](http://www.bifma.org).
41. CFFA - Chemical Fabrics and Film Association, Inc.; [www.chemicalfabricsandfilm.com](http://www.chemicalfabricsandfilm.com).
42. CFSEI - Cold-Formed Steel Engineers Institute; [www.cfsei.org](http://www.cfsei.org).
43. CGA - Compressed Gas Association; [www.cganet.com](http://www.cganet.com).
44. CISCA - Ceilings & Interior Systems Construction Association; [www.cisca.org](http://www.cisca.org).
45. CISPI - Cast Iron Soil Pipe Institute; [www.cispi.org](http://www.cispi.org).
46. CPA - Composite Panel Association; [www.compositepanel.org](http://www.compositepanel.org).
47. CRI - Carpet and Rug Institute (The); [www.carpet-rug.org](http://www.carpet-rug.org).
48. CRRC - Cool Roof Rating Council; [www.coolroofs.org](http://www.coolroofs.org).
49. CRSI - Concrete Reinforcing Steel Institute; [www.crsi.org](http://www.crsi.org).
50. CSA - CSA Group; [www.csa-group.org](http://www.csa-group.org).
51. CSI - Cast Stone Institute; [www.caststone.org](http://www.caststone.org).
52. CSI - Construction Specifications Institute (The); [www.csiresources.org](http://www.csiresources.org).
53. CTA - Consumer Technology Association; [www.cta.tech](http://www.cta.tech).
54. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); [www.coolingtechnology.org](http://www.coolingtechnology.org).
55. CWC - Composite Wood Council; (See CPA).
56. DASMA - Door and Access Systems Manufacturers Association; [www.dasma.com](http://www.dasma.com).
57. DHA - Decorative Hardwoods Association; (Formerly: Hardwood Plywood & Veneer Association); [www.decorativehardwoods.org](http://www.decorativehardwoods.org).
58. DHI - Door and Hardware Institute; [www.dhi.org](http://www.dhi.org).
59. ECA - Electronic Components Association; (See ECIA).
60. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
61. ECIA - Electronic Components Industry Association; [www.ecianow.org](http://www.ecianow.org).
62. EIA - Electronic Industries Alliance; (See TIA).
63. ETL - Intertek (See Intertek); [www.intertek.com](http://www.intertek.com).
64. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
65. .

66. FM Approvals - FM Approvals LLC; [www.fmaprovals.com](http://www.fmaprovals.com).
67. FM Global - FM Global; (Formerly: FMG - FM Global); [www.fmglobal.com](http://www.fmglobal.com).
68. FRSA - Florida Roofing, Sheet Metal Contractors Association, Inc.; [www.floridarooft.com](http://www.floridarooft.com).
69. FSA - Fluid Sealing Association; [www.fluidsealing.com](http://www.fluidsealing.com).
70. FSC - Forest Stewardship Council U.S.; [www.fscus.org](http://www.fscus.org).
71. GA - Gypsum Association; [www.gypsum.org](http://www.gypsum.org).
72. GANA - Glass Association of North America; (See NGA).
73. GS - Green Seal; [www.greenseal.org](http://www.greenseal.org).
74. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
75. HPVA - Hardwood Plywood & Veneer Association; (See DHA).
76. IAPSC - International Association of Professional Security Consultants; [www.iapsc.org](http://www.iapsc.org).
77. IAS - International Accreditation Service; [www.iasonline.org](http://www.iasonline.org).
78. ICBO - International Conference of Building Officials; (See ICC).
79. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
80. ICEA - Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
81. ICPA - International Cast Polymer Association; [www.theicpa.com](http://www.theicpa.com).
82. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); [www.ieee.org](http://www.ieee.org).
83. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); [www.ies.org](http://www.ies.org).
84. IESNA - Illuminating Engineering Society of North America; (See IES).
85. IEST - Institute of Environmental Sciences and Technology; [www.iest.org](http://www.iest.org).
86. IGMA - Insulating Glass Manufacturers Alliance; (See FGIA).
87. IGSHPA - International Ground Source Heat Pump Association; [www.igshpa.org](http://www.igshpa.org).
88. II - Infocomm International; (See AVIXA).
89. ILI - Indiana Limestone Institute of America, Inc.; [www.ili.ai.com](http://www.ili.ai.com).
90. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); [www.intertek.com](http://www.intertek.com).
91. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
92. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); [www.isfanow.org](http://www.isfanow.org).
93. ISO - International Organization for Standardization; [www.iso.org](http://www.iso.org).
94. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
95. LMA - Laminating Materials Association; (See CPA).
96. LPI - Lightning Protection Institute; [www.lightning.org](http://www.lightning.org).
97. MCA - Metal Construction Association; [www.metalconstruction.org](http://www.metalconstruction.org).
98. MFMA - Metal Framing Manufacturers Association, Inc.; [www.metalframingmfg.org](http://www.metalframingmfg.org).
99. MHI - Material Handling Industry; [www.mhi.org](http://www.mhi.org).
100. MMPA - Moulding & Millwork Producers Association; [www.wmmpa.com](http://www.wmmpa.com).
101. MPI - Master Painters Institute; [www.paintinfo.com](http://www.paintinfo.com).
102. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; [www.mss-hq.org](http://www.mss-hq.org).
103. NAAMM - National Association of Architectural Metal Manufacturers; [www.naamm.org](http://www.naamm.org).
104. .
105. NAIMA - North American Insulation Manufacturers Association; [www.naima.org](http://www.naima.org).
106. NALP - National Association of Landscape Professionals; [www.landscapeprofessionals.org](http://www.landscapeprofessionals.org).
107. NBI - New Buildings Institute; [www.newbuildings.org](http://www.newbuildings.org).

108. NCMA - National Concrete Masonry Association; [www.ncma.org](http://www.ncma.org).
109. NEBB - National Environmental Balancing Bureau; [www.nebb.org](http://www.nebb.org).
110. NECA - National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).
111. NeLMA - Northeastern Lumber Manufacturers Association; [www.nelma.org](http://www.nelma.org).
112. NEMA - National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
113. NETA - InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
114. NFPA - National Fire Protection Association; [www.nfpa.org](http://www.nfpa.org).
115. NFPA - NFPA International; (See NFPA).
116. NFRC - National Fenestration Rating Council; [www.nfrc.org](http://www.nfrc.org).
117. NGA - National Glass Association (The); (Formerly: Glass Association of North America); [www.glass.org](http://www.glass.org).
118. NHLA - National Hardwood Lumber Association; [www.nhla.com](http://www.nhla.com).
119. NLGA - National Lumber Grades Authority; [www.nlga.org](http://www.nlga.org).
120. NOMMA - National Ornamental & Miscellaneous Metals Association; [www.nomma.org](http://www.nomma.org).
121. NRCA - National Roofing Contractors Association; [www.nrca.net](http://www.nrca.net).
122. NRMCA - National Ready Mixed Concrete Association; [www.nrmca.org](http://www.nrmca.org).
123. NSF - NSF International; [www.nsf.org](http://www.nsf.org).
124. NSI - National Stone Institute; (Formerly: Marble Institute of America); [www.naturalstoneinstitute.org](http://www.naturalstoneinstitute.org).
125. NSPE - National Society of Professional Engineers; [www.nspe.org](http://www.nspe.org).
126. NSSGA - National Stone, Sand & Gravel Association; [www.nssga.org](http://www.nssga.org).
127. NTMA - National Terrazzo & Mosaic Association, Inc. (The); [www.ntma.com](http://www.ntma.com).
128. NWFA - National Wood Flooring Association; [www.nwfa.org](http://www.nwfa.org).
129. NWRA - National Waste & Recycling Association; [www.wasterecycling.org](http://www.wasterecycling.org).
130. PCI - Precast/Prestressed Concrete Institute; [www.pci.org](http://www.pci.org).
131. PDI - Plumbing & Drainage Institute; [www.pdionline.org](http://www.pdionline.org).
132. RCSC - Research Council on Structural Connections; [www.boltcouncil.org](http://www.boltcouncil.org).
133. RFCI - Resilient Floor Covering Institute; [www.rfci.com](http://www.rfci.com).
134. SAE - SAE International; [www.sae.org](http://www.sae.org).
135. SCTE - Society of Cable Telecommunications Engineers; [www.scte.org](http://www.scte.org).
136. SDI - Steel Deck Institute; [www.sdi.org](http://www.sdi.org).
137. SDI - Steel Door Institute; [www.steeldoor.org](http://www.steeldoor.org).
138. SEFA - Scientific Equipment and Furniture Association (The); [www.sefalabs.com](http://www.sefalabs.com).
139. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
140. SIA - Security Industry Association; [www.siaonline.org](http://www.siaonline.org).
141. SJI - Steel Joist Institute; [www.steeljoist.org](http://www.steeljoist.org).
142. SMA - Screen Manufacturers Association; [www.smainfo.org](http://www.smainfo.org).
143. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; [www.smacna.org](http://www.smacna.org).
144. SPFA - Spray Polyurethane Foam Alliance; [www.sprayfoam.org](http://www.sprayfoam.org).
145. SPIB - Southern Pine Inspection Bureau; [www.spib.org](http://www.spib.org).
146. SPRI - Single Ply Roofing Industry; [www.spri.org](http://www.spri.org).
147. SRCC - Solar Rating & Certification Corporation; [www.solar-rating.org](http://www.solar-rating.org).
148. SSINA - Specialty Steel Industry of North America; [www.ssina.com](http://www.ssina.com).
149. SSPC - SSPC: The Society for Protective Coatings; [www.sspc.org](http://www.sspc.org).
150. STI - Steel Tank Institute; [www.steeltank.com](http://www.steeltank.com).
151. SWI - Steel Window Institute; [www.steelwindows.com](http://www.steelwindows.com).
152. SWPA - Submersible Wastewater Pump Association; [www.swpa.org](http://www.swpa.org).

153. TCNA - Tile Council of North America, Inc.; [www.tileusa.com](http://www.tileusa.com).
154. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); [www.tiaonline.org](http://www.tiaonline.org).
155. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
156. TMS - The Masonry Society; [www.masonrysociety.org](http://www.masonrysociety.org).
157. TPI - Truss Plate Institute; [www.tpinst.org](http://www.tpinst.org).
158. TPI - Turfgrass Producers International; [www.turfgrasssod.org](http://www.turfgrasssod.org).
159. TRI - Tile Roofing Institute; [www.tilerroofing.org](http://www.tilerroofing.org).
160. UL - Underwriters Laboratories Inc.; [www.ul.com](http://www.ul.com).
161. UL LLC - UL LLC; [www.ul.com](http://www.ul.com).
162. UNI - Uni-Bell PVC Pipe Association; [www.uni-bell.org](http://www.uni-bell.org).
163. USGBC - U.S. Green Building Council; [www.usgbc.org](http://www.usgbc.org).
164. USITT - United States Institute for Theatre Technology, Inc.; [www.usitt.org](http://www.usitt.org).
165. WA - Wallcoverings Association; [www.wallcoverings.org](http://www.wallcoverings.org).
166. WCLIB - West Coast Lumber Inspection Bureau; [www.wclib.org](http://www.wclib.org).
167. WCMA - Window Covering Manufacturers Association; [www.wcmanet.org](http://www.wcmanet.org).
168. WDMA - Window & Door Manufacturers Association; [www.wdma.com](http://www.wdma.com).
169. WI - Woodwork Institute; [www.wicnet.org](http://www.wicnet.org).
170. WSRCA - Western States Roofing Contractors Association; [www.wsrca.com](http://www.wsrca.com).
171. WWPA - Western Wood Products Association; [www.wwpa.org](http://www.wwpa.org).

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut fur Normung e.V.; [www.din.de](http://www.din.de).
2. IAPMO - International Association of Plumbing and Mechanical Officials; [www.iapmo.org](http://www.iapmo.org).
3. ICC - International Code Council; [www.iccsafe.org](http://www.iccsafe.org).
4. ICC-ES - ICC Evaluation Service, LLC; [www.icc-es.org](http://www.icc-es.org).

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; [www.usace.army.mil](http://www.usace.army.mil).
2. CPSC - Consumer Product Safety Commission; [www.cpsc.gov](http://www.cpsc.gov).
3. DOC - Department of Commerce; National Institute of Standards and Technology; [www.nist.gov](http://www.nist.gov).
4. DOD - Department of Defense; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
5. DOE - Department of Energy; [www.energy.gov](http://www.energy.gov).
6. EPA - Environmental Protection Agency; [www.epa.gov](http://www.epa.gov).
7. FAA - Federal Aviation Administration; [www.faa.gov](http://www.faa.gov).
8. FG - Federal Government Publications; [www.gpo.gov/fdsys](http://www.gpo.gov/fdsys).
9. GSA - General Services Administration; [www.gsa.gov](http://www.gsa.gov).
10. HUD - Department of Housing and Urban Development; [www.hud.gov](http://www.hud.gov).

11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; [www.eetd.lbl.gov](http://www.eetd.lbl.gov).
  12. OSHA - Occupational Safety & Health Administration; [www.osha.gov](http://www.osha.gov).
  13. SD - Department of State; [www.state.gov](http://www.state.gov).
  14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; [www.trb.org](http://www.trb.org).
  15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; [www.ars.usda.gov](http://www.ars.usda.gov).
  16. USDA - Department of Agriculture; Rural Utilities Service; [www.usda.gov](http://www.usda.gov).
  17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; [www.ojp.usdoj.gov](http://www.ojp.usdoj.gov).
  18. USP - U.S. Pharmacopeial Convention; [www.usp.org](http://www.usp.org).
  19. USPS - United States Postal Service; [www.usps.com](http://www.usps.com).
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; [www.govinfo.gov](http://www.govinfo.gov).
  2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
  3. DSCC - Defense Supply Center Columbus; (See FS).
  4. FED-STD - Federal Standard; (See FS).
  5. FS - Federal Specification; Available from DLA Document Services; [www.quicksearch.dla.mil](http://www.quicksearch.dla.mil).
    - a. Available from Defense Standardization Program; [www.dsp.dla.mil](http://www.dsp.dla.mil).
    - b. Available from General Services Administration; [www.gsa.gov](http://www.gsa.gov).
    - c. Available from National Institute of Building Sciences/Whole Building Design Guide; [www.wbdg.org](http://www.wbdg.org).
  6. MILSPEC - Military Specification and Standards; (See DOD).
  7. USAB - United States Access Board; [www.access-board.gov](http://www.access-board.gov).
  8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; [www.bearhfti.ca.gov](http://www.bearhfti.ca.gov).
  2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; [www.calregs.com](http://www.calregs.com).
  3. CDHS; California Department of Health Services; (See CDPH).

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

4. CDPH; California Department of Public Health; Indoor Air Quality Program; [www.cdph.ca.gov/Programs/CCDCPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx](http://www.cdph.ca.gov/Programs/CCDCPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx).
5. CPUC; California Public Utilities Commission; [www.cpuc.ca.gov](http://www.cpuc.ca.gov).
6. SCAQMD; South Coast Air Quality Management District; [www.aqmd.gov](http://www.aqmd.gov).
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; [www.txforestservation.tamu.edu](http://www.txforestservation.tamu.edu).

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

## SECTION 014339 - MOCKUPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Integrated exterior mockup.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for quality assurance requirements for aesthetic and workmanship mockups specified in other Sections.
2. Section 019119.43 "Exterior Enclosure Commissioning" for testing building enclosure systems and assemblies as part of the exterior enclosure commissioning process.

#### 1.2 DEFINITIONS

- A. In-Place Exterior Mockups: Mockups of the exterior envelope constructed on-site consisting of multiple products, assemblies, and subassemblies for checking performance characteristics.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, testing and inspecting agency representative, and installers of major systems whose Work is included in in-place exterior mockup.
2. Review locations and extent of mockups.
3. Review testing procedures to be performed on mockups.
4. Review and finalize schedule for mockups, and verify availability of materials, personnel, equipment, and facilities needed to complete mockups and testing and maintain schedule for the Work.

#### 1.4 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups.

1. Include plans, elevations, sections, and mounting attachment and support details.
2. Indicate manufacturer and model number of individual components, subassemblies, and assemblies.
3. Include site location drawing indicating orientation of mockup.
4. Revise and resubmit Shop Drawings to reflect approved modifications in details and component interfaces resulting from changes made during testing procedures.



- B. Delegated Design Submittal: For temporary structural supports for mockups not attached to building structure, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.

## 1.6 QUALITY ASSURANCE

- A. Build mockups to do the following:

1. Verify selections made under Sample submittals.
2. Demonstrate aesthetic effects.
3. Demonstrate the qualities of products and workmanship.
4. Demonstrate acceptable coordination between components and systems.
5. Perform preconstruction testing, such as window air- and water-leakage testing.

- B. Fabrication: Before fabricating or installing portions of the Work requiring mockups, build mockups for each form of construction and finish required. Use materials and installation methods as required for the Work.

1. Build mockups of size indicated
  - a. Typical exterior wall section approximately 10 feet wide by 10 feet tall include curtainwall 2 feet wide by five feet tall, and include typical base condition and parapet.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed unless otherwise indicated.

- C. Notifications:

1. Notify Architect seven days in advance of the dates and times when mockups will be constructed.
2. Notify Architect 14 days in advance of the dates and times when mockups will be tested.
3. Allow seven days for initial review and each re-review of each mockup.

- D. Approval: Obtain Architect's approval of mockups before starting fabrication or construction of corresponding Work.

1. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.



2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved laboratory casework mockups may become part of the completed Work if undisturbed at time of Final Completion.

## 1.7 COORDINATION

- A. Coordinate schedule for construction of mockups, so construction, testing, and review of mockups do not impact Project schedule.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design support structure for free-standing mockups.
- B. Structural Performance:
  1. Seismic Performance: Mockups and support structure to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.
  2. Wind Loads: As indicated on Drawings.
- C. Mockup Testing Performance Requirements: Perform tests using design pressures and performance criteria indicated for assemblies and products that are specified in other Sections and incorporated into integrated exterior mockups.

### 2.2 IN-PLACE EXTERIOR MOCKUPS

- A. Construct in-place exterior mockups according to approved mockup Shop Drawings. Construct mockups to demonstrate constructability, coordination of trades, and sequencing of Work; and to ensure materials, components, subassemblies, assemblies, and interfaces integrate into a system complying with indicated performance and aesthetic requirements.
- B. Build in-place exterior mockups using installers and construction methods that will be used in completed construction.
- C. Use specified products that have been approved by Architect. Coordinate installation of materials and products specified in individual Specification Sections that include Work included in in-place exterior mockups.
- D. The Work of in-place exterior mockups includes, but is not limited to, the following:
  1. Cold-formed metal framing and sheathing.
  2. Air and weather barriers.

3. Thermal insulation.
  4. Through-wall flashing.
  5. Flashing and sheet metal trim.
  6. Joint sealants.
  7. Metal wall panels.
  8. Aluminum-framed entrances and storefront.
  9. Glazed curtain walls.
  10. Glazing.
- E. Photographic Documentation: Document construction of integrated exterior mockups with photographs in accordance with Section 013233 "Photographic Documentation." Provide photographs showing details of interface of different materials and assemblies.
1. Document testing procedures, including water leakage and other deficiencies. Photograph modifications to component interfaces intended to correct deficiencies.
- F. Provide and document modifications to construction details and interfaces between components and systems required to properly sequence the Work, or to pass performance testing requirements. Obtain Architect's approval for modifications.

### PART 3 - EXECUTION

#### 3.1 TESTING OF IN-PLACE EXTERIOR MOCKUPS

- A. In-place Exterior Mockup Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
1. Testing and inspecting agency will interpret tests and state in each report whether tested Work complies with or deviates from requirements.
- B. In-place Exterior Mockup Testing Services: Perform the following tests in the following order:
1. Water-Spray Test: Before installation of interior finishes has begun, test areas designated by Architect in accordance with AAMA 501.2 for evidence of water penetration.
    - a. Perform a minimum of three tests in areas as directed by Architect.
  2. Air Leakage: Test in accordance with ASTM E783 at 1.5 times the rate specified in "Mockup Testing Performance Requirements" Paragraph in "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
    - a. Perform a minimum of three tests in areas as directed by Architect.
  3. Water Penetration: Test in accordance with ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Mockup Testing Performance Requirements"

Paragraph in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and verify no evidence of water penetration.

- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections, and also to observe testing for the following systems and assemblies.
  - 1. Curtain wall specified in Section 084413 "Glazed Aluminum Curtain Walls."
- D. In-place exterior mockup will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 014339



## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

#### 1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Pay water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within **15** days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
  - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
  - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
  - 3. Indicate methods to be used to avoid trapping water in finished work.
- F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste-handling procedures.
  - 5. Other dust-control measures.
- G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
  - 1. Methods used to meet the goals and requirements of the Owner.
  - 2. Concrete cutting method(s) to be used.
  - 3. Location of construction devices on the site.
  - 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
  - 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.

## 1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch-OD top rails. Needs to be secured and with non-see through screen with graphics of building rendering and project info.
- B. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

### 2.2 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  - 1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
  - 3. Drinking water and private toilet.
  - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  - 5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

### 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
  - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

### PART 3 - EXECUTION

#### 3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
  - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

#### 3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

#### 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.



1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
  1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities is not permitted.
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
  1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel.
  1. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Contractor's emergency after-hours telephone number.
    - e. Architect's office.
    - f. Engineers' offices.
    - g. Owner's office.
    - h. Principal subcontractors' field and home offices.
- I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
2. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.

### 3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds as coordinated with the Owner that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Maintain support facilities until Architect schedules Final Acceptance inspection. Remove before Final Acceptance. Personnel remaining after Final Acceptance will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

C. Parking: Coordinate parking areas for construction personnel with the Owner.

D. Storage and Staging: **Use designated areas of Project site in south parking lot as shown on civil drawings** for storage and staging needs.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
  - a. Provide temporary, directional signs for construction personnel and visitors.
3. Maintain and touch up signs, so they are legible at all times.

G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Elevator Use: Use of elevators is not permitted.
- J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- K. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Final Acceptance.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
  1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - 1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
  - 1. Protect porous materials from water damage.
  - 2. Protect stored and installed material from flowing or standing water.
  - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
  - 4. Remove standing water from decks.
  - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  - 2. Keep interior spaces reasonably clean and protected from water damage.
  - 3. Periodically collect and remove waste containing cellulose or other organic matter.
  - 4. Discard or replace water-damaged material.
  - 5. Do not install material that is wet.
  - 6. Discard and replace stored or installed material that begins to grow mold.

7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
  3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
    - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

### 3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- B. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Acceptance.
- C. 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 Final Acceptance. 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. At Final Acceptance, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000



## SECTION 015526 - TEMPORARY TRAFFIC CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Temporary Traffic Control Devices.

#### 1.2 REFERENCE STANDARDS

- A. State Department of Transportation (DOT)
  - 1. State Department of Transportation Standard Specifications for Roads and Structures, latest edition.
  - 2. State Department of Transportation Standard Roadway Drawings, latest edition.
- B. Manual on Uniform Traffic Control Devices (MUTCD)

#### 1.3 COORDINATION

- A. Section 013000 - Administrative Requirements specifies requirements for coordination.
- B. Coordinate Work of this Section with authorities having jurisdiction.

#### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures specifies requirements for submittals.
- B. The CONTRACTOR shall submit to the ENGINEER a written construction sequence for traffic control prior to the pre-construction meeting and the sequence must be approved before closing a lane of traffic. The CONTRACTOR and ENGINEER shall coordinate with all authorities having jurisdiction prior to the implementation of the traffic control plan.
- C. The CONTRACTOR installing and maintaining the temporary traffic control devices shall provide the following certifications at the Project's pre-construction meeting:
  - 1. DOT Work Zone Traffic Control Supervisor Certification
  - 2. DOT Work Zone Traffic Control Installer Certification
  - 3. DOT Work Zone Traffic Control Flagger Certification
  - 4. Or an equivalent combination of certifications to satisfy the local jurisdiction having authority over the project.

## 1.5 QUALITY ASSURANCE

- A. Install and maintain the temporary traffic control devices according to State DOT standards and current requirements of authorities having jurisdiction.

## 1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to installation of the temporary traffic control devices.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Provide temporary traffic control devices that are listed on the DOT approved products list.

## PART 3 - EXECUTION

### 3.1 FIELD MEETING

- A. CONTRACTOR shall coordinate a field meeting with the authorities having jurisdiction prior to installing the temporary traffic control devices.

### 3.2 EXAMINATION

- 3.3 Section 017000 - Execution and Closeout Requirements specifies requirements for installation examination.

### 3.4 INSTALLATION

- A. Install temporary traffic control devices before construction begins and during the proper phase of construction. Keep devices in place if they are needed and immediately remove thereafter. When operations are performed in stages, install only those devices that are applicable to the current stage of construction.

### 3.5 MAINTENANCE AND INSPECTION

- A. The CONTRACTOR shall perform continuous maintenance and daily inspections of all traffic control devices.



- B. Maintenance activities include prompt cleaning, repair, or replacement and disposal of devices that are damaged and are no longer effective.

### 3.6 FAILURE TO MAINTAIN TRAFFIC CONTROL

- A. Failure to comply with these requirements and the approved traffic control plan may result in a suspension of all other operations. Implement remedial action immediately for imminent danger situations and within 48-hours after notification of a non-life-threatening safety issue.

### 3.7 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements specifies requirements for inspecting and testing.
- B. Section 017000 - Execution and Closeout Requirements specifies requirements for testing, adjusting, and balancing.

### 3.8 CLEANING

- A. Section 017000 - Execution and Closeout Requirements specifies requirements for cleaning.

### 3.9 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements specifies requirements for protecting finished Work.

END OF SECTION 015526



**SECTION 0156390 - TEMPORARY TREE AND PLANT PROTECTION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

**1.2 SUMMARY**

- A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
  - 1. Section 01 5000 "Temporary Facilities and Controls" for temporary site fencing.
  - 2. Section 31 1000 "Site Clearing" for removing existing trees and shrubs.

**1.3 DEFINITIONS**

- A. Caliper: Diameter of a trunk measured by a diameter tape at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

**1.4 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site with the Owner.
  - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
    - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
    - b. Arborist's responsibilities.
    - c. Quality-control program.
    - d. Coordination of Work and equipment movement with the locations of protection zones.
    - e. Trenching by hand or with air spade within protection zones.
    - f. Field quality control.

**1.5 ACTION SUBMITTALS**

- A. Product Data: For each type of product that may be used or needed in the project.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
  - 2. Detail fabrication and assembly of protection-zone fencing and signage.
  - 3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. Samples: For each type of the following:

1. Organic Mulch: 1-quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
  1. Species and size of tree.
  2. Location on site plan. Include unique identifier for each.
  3. Reason for pruning.
  4. Description of pruning to be performed.
  5. Description of maintenance following pruning.

## **1.6 QUALITY ASSURANCE**

- A. Arborist Qualifications: Certified Arborist as certified by ISA.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

## **1.7 FIELD CONDITIONS**

- A. The following practices are prohibited within protection zones:
  1. Storage of construction materials, debris, or excavated material.
  2. Moving or parking vehicles or equipment.
  3. Foot traffic.
  4. Erection of sheds or structures.
  5. Impoundment of water.
  6. Excavation or other digging unless otherwise indicated.
  7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
  1. Mixture: Well-blended mix of two parts stockpiled soil to one part planting soil.
  2. Planting Soil: Planting soil as specified in Section 32 9300 "Plants".
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:

1. Type: As specified in Section 32 9300 "Plants".
- C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements: Previously used materials may be used when approved by Architect.
  1. Chain-Link Protection-Zone Fencing: Galvanized-steel, or polymer-coated steel, or polymer-coated galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch-diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch-OD line posts, and 2-7/8-inch-OD corner and pull posts; with 1-5/8-inch-OD top rails; with 0.177-inch-diameter top tension wire and 0.177-inch-diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
    - a. Height: Minimum 6 feet.
    - b. Polymer-Coating Color: Natural galvanized.
  2. Gates: Single-swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 48 inches.
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
  1. Size and Text: As shown on Drawings.
  2. Lettering: As shown on Drawings.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

#### **3.2 PREPARATION**

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag Tie a 1-inch blue vinyl tape around each tree trunk at 54 inches above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
  1. Apply depth sufficient to supplement existing mulch layer to not exceed 3 inches total depth of existing and new mulch with a uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

#### **3.3 PROTECTION ZONES**

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
  1. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written instructions.

2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
3. Access Gates: Access gates are not allowed.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately as shown on Drawings on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
  1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
  2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

### **3.4 EXCAVATION**

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 31 2000 "Earth Moving" unless otherwise indicated.
- B. Trenching within Protection Zones: Not allowed.
- C. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

### **3.5 ROOT PRUNING**

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
  1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
  2. Cut Ends: Do not paint cut root ends.
  3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
  4. Cover exposed roots with burlap and water regularly.
  5. Backfill as soon as possible according to requirements in Section 31 2000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune tree roots flush with the edge of the protection zone by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

### **3.6 FIELD QUALITY CONTROL**

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

### **3.7 REPAIR AND REPLACEMENT**

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
  - 1. Submit details of proposed pruning and repairs.
  - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
  - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 30 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
  - 1. Small Trees: Provide new trees of same size as those being replaced for each tree that measures less than 6 inches caliper size.
    - a. Species: As selected by Owner staff.
  - 2. Large Trees: Provide minimum 4-inch to 6-inch caliper trees in quantity equal to total caliper of each damaged tree that measures 6 inches or larger in caliper size.
    - a. Species: As selected by Owner staff.
  - 3. Plant and maintain new trees as specified in Section 32 9300 "Plants."
- C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 3-inch uniform thickness to remain.
- D. Soil Aeration: Where directed by Duke Garden's staff or Arborist, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch-diameter holes a minimum of 12 inches deep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

### **3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS**

- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

**END OF SECTION 015639**





## SECTION 016000 - PRODUCT REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
  - 2. Section 012100 "Allowances" for products selected under an allowance.
  - 3. Section 012300 "Alternates" for products selected under an alternate.
  - 4. Section 012500 "Substitution Procedures" for requests for substitutions.
  - 5. Section 014200 "References" for applicable industry standards for products specified.
  - 6. Section 01770 "Closeout Procedures" for submitting warranties.

#### 1.3 DEFINITIONS

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

- B. **Basis-of-Design Product Specification:** A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
- C. **Subject to Compliance with Requirements:** Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

#### 1.4 QUALITY ASSURANCE

- A. **Compatibility of Options:** If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
  - 1. **Resolution of Compatibility Disputes between Multiple Contractors:**
    - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
    - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. **Identification of Products:** Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
  - 1. **Labels:** Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
  - 2. **Equipment Nameplates:** Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
    - a. Name of product and manufacturer.
    - b. Model and serial number.
    - c. Capacity.
    - d. Speed.
    - e. Ratings.
  - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

## 1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
  - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
  - 2. Store products to allow for inspection and measurement of quantity or counting of units.
  - 3. Store materials in a manner that will not endanger Project structure.
  - 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
  - 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  - 7. Protect stored products from damage and liquids from freezing.
  - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

## 1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

## PART 2 - PRODUCTS

### 2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered.
    - a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  - a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
  - a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.
  - a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
  - a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
  - a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
  - b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in

"Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.
- E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.
1. Select products for which sustainable design documentation submittals are available from manufacturer.

## 2.2 COMPARABLE PRODUCTS

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

- B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
  - 1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
  - 2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000





## SECTION 017300 - EXECUTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

- B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products, and limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

#### 1.2 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

#### 1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.

1. Prior to submitting cutting and patching plan, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
  - a. Contractor's superintendent.
  - b. Trade supervisor responsible for cutting operations.
  - c. Trade supervisor(s) responsible for patching of each type of substrate.
  - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

B. Layout Conference: Conduct conference at Project site.

1. Prior to establishing layout of new perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
  - a. Contractor's superintendent.
  - b. Professional surveyor responsible for performing Project surveying and layout.
2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
3. Review requirements for including layouts on Shop Drawings and other submittals.
4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certified Surveys: Submit two copies signed by land surveyor.
- C. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.
- D. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
  1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
  2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
  3. Products: List products to be used for patching and firms or entities that will perform patching work.

4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
  - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

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

## 1.5 CLOSEOUT SUBMITTALS

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

## 1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
    - a. Primary operational systems and equipment.
    - b. Fire separation assemblies.
    - c. Air or smoke barriers.
    - d. Fire-suppression systems.
    - e. Plumbing piping systems.
    - f. Mechanical systems piping and ducts.
    - g. Control systems.
    - h. Communication systems.
    - i. Fire-detection and -alarm systems.

- j. Conveying systems.
  - k. Electrical wiring systems.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
- a. Water, moisture, or vapor barriers.
  - b. Membranes and flashings.
  - c. Exterior curtain-wall construction.
  - d. Equipment supports.
  - e. Piping, ductwork, vessels, and equipment.
  - f. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

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

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
  2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
  1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
  2. List of detrimental conditions, including substrates.
  3. List of unacceptable installation tolerances.
  4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect in accordance with requirements in Section 013100 "Project Management and Coordination."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.
- B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish limits on use of Project site.
  - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 4. Inform installers of lines and levels to which they must comply.
  - 5. Check the location, level and plumb, of every major element as the Work progresses.
  - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of **two** permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  - 2. Recording: At Final Acceptance, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb, and make horizontal work level.
  - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Final Acceptance.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
  - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  - 2. Allow for building movement, including thermal expansion and contraction.
  - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.



### 3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
  4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.

- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Final Acceptance.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Final Acceptance.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Final Acceptance.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

## SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Recycling nonhazardous demolition and construction waste.
  - 2. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
  - 1. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
  - 2. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

#### 1.3 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent recycling, or deposit in landfill, or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

#### 1.4 MATERIALS OWNERSHIP

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

## 1.5 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within 7 days of date established for commencement of the Work.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste. Include the following information:
  - 1. Material category.
  - 2. Generation point of waste.
  - 3. Total quantity of waste in tons.
  - 4. Quantity of waste recycled, both estimated and actual in tons.
  - 5. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Final Acceptance, submit calculated end-of-Project rates for recycling, and disposal as a percentage of total waste generated by the Work.
- C. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- D. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- E. Qualification Data: For waste management coordinator.

## 1.7 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.
- B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

## 1.8 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to 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.

- B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Use Form CWM-1 for construction waste. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
  - 1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
  - 2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
  - 3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for recycling of 50 percent by weight of total nonhazardous 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.

## PART 3 - EXECUTION

### 3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
  - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
  2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
  2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

### 3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
    - a. Inspect containers and bins for contamination and remove contaminated materials if found.
  2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
  4. Store components off the ground and protect from the weather.
  5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

### 3.3 RECYCLING CONSTRUCTION WASTE

- A. 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.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
  - a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

- a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

D. Paint: Seal containers and store by type.

3.4 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.

C. Burning: Do not burn waste materials.

3.5 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-3 for construction waste reduction work plan.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

C. Form CWM-7 for construction waste reduction progress report.

END OF SECTION 017419

## SECTION 017700 - CLOSEOUT PROCEDURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
  - 1. Final Acceptance procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
- B. Related Requirements:
  - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Final Acceptance and Final Completion.
  - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
  - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
  - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
  - 5. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

#### 1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is final complete.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Final Acceptance.

- C. Certified List of Incomplete Items: Final submittal at Final Completion.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

#### 1.7 FINAL ACCEPTANCE PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Final Acceptance: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Final Acceptance. List items below that are incomplete at time of request.
  - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
  - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
  - 5. Submit testing, adjusting, and balancing records.
  - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

- C. Procedures Prior to Final Acceptance: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Final Acceptance. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Final Acceptance.
  5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
  6. Advise Owner of changeover in utility services.
  7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  9. Complete final cleaning requirements.
  10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Final Acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Final Acceptance after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for Final Completion.

## 1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Final Acceptance inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
  5. Submit Final Completion photographic documentation.

- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
  - 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
  - 1. Organize list of spaces in sequential order, listed by room or space number.
  - 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
  - 3. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.
  - 4. Submit list of incomplete items in the following format:
    - a. PDF Electronic File: Architect will return annotated file.

#### 1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties for designated portions of the Work where warranties are indicated to commence on dates other than date of Final Acceptance, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
  - 1. Submit on digital media acceptable to Architect.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

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

## PART 3 - EXECUTION

### 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Final Acceptance for entire Project or for a designated portion of Project:
    - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
    - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
    - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
    - f. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - g. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
    - h. Vacuum and mop concrete.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.

- j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - o. Clean ducts, blowers, and coils.
  - p. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
  - q. Clean strainers.
  - r. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Final Acceptance.

END OF SECTION 017700



## SECTION 017823 - OPERATION AND MAINTENANCE DATA

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.
- B. Related Requirements:
  - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 2. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

#### 1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  1. Submit by email to Architect. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Final Acceptance and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
  1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

#### 1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

#### 1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  1. Title page.
  2. Table of contents.
  3. Manual contents.

- B. Title Page: Include the following information:
1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Architect.
  7. Name and contact information for Commissioning Authority.
  8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  9. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

#### 1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
  2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
  3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

#### 1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

## 1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.

5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.

2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.
- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  1. Include procedures to follow and required notifications for warranty claims.
- J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  1. Do not use original project record documents as part of maintenance manuals.

#### 1.11 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
  1. Product name and model number.
  2. Manufacturer's name.
  3. Color, pattern, and texture.
  4. Material and chemical composition.
  5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  1. Inspection procedures.

2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823



## SECTION 017839 - PROJECT RECORD DOCUMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
  - 1. Record Drawings.
  - 2. Record specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 017300 "Execution" for final property survey.
  - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
  - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit copies of Record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
      - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit PDF electronic files of scanned Record Prints and three HARD COPY set(s) of file prints.
    - c. Final Submittal:

- 1) Submit Record Digital Data Files and one set of Record Digital Data File plots.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

#### 1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.

5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Final Acceptance, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
- C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Format: Annotated PDF electronic file with comment function enabled.
  2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  3. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 1.5 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
- B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
- C. Format: Submit Record Product Data as annotated PDF electronic file.
  - 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

## SECTION 017900 - DEMONSTRATION AND TRAINING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
  - 2. Demonstration and training video recordings.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Attendance Record: For each training module, submit list of participants and length of instruction time.
- C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.
    - b. Name and address of videographer.
    - c. Name of Architect.

- d. Name of Construction Manager.
  - e. Name of Contractor.
  - f. Date of video recording.
- 2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
  - 3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

#### 1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

#### 1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

## 1.7 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Systems and equipment operation manuals.
    - c. Systems and equipment maintenance manuals.
    - d. Product maintenance manuals.
    - e. Project Record Documents.
    - f. Identification systems.
    - g. Warranties and bonds.
    - h. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
  - 4. Operations: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Control sequences.

- f. Safety procedures.
    - g. Instructions on stopping.
    - h. Normal shutdown instructions.
    - i. Operating procedures for emergencies.
    - j. Operating procedures for system, subsystem, or equipment failure.
    - k. Seasonal and weekend operating instructions.
    - l. Required sequences for electric or electronic systems.
    - m. Special operating instructions and procedures.
  - 5. Adjustments: Include the following:
    - a. Alignments.
    - b. Checking adjustments.
    - c. Noise and vibration adjustments.
    - d. Economy and efficiency adjustments.
  - 6. Troubleshooting: Include the following:
    - a. Diagnostic instructions.
    - b. Test and inspection procedures.
  - 7. Maintenance: Include the following:
    - a. Inspection procedures.
    - b. Types of cleaning agents to be used and methods of cleaning.
    - c. List of cleaning agents and methods of cleaning detrimental to product.
    - d. Procedures for routine cleaning.
    - e. Procedures for preventive maintenance.
    - f. Procedures for routine maintenance.
    - g. Instruction on use of special tools.
  - 8. Repairs: Include the following:
    - a. Diagnosis instructions.
    - b. Repair instructions.
    - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    - d. Instructions for identifying parts and components.
    - e. Review of spare parts needed for operation and maintenance.
- 1.8 PREPARATION
- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
  - B. Set up instructional equipment at instruction location.



1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
  - 2. Important training videos include, but not limited to, are the following:
    - a. BAS controls
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a commercial videographer using a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
  - 1. Submit video recordings on CD-ROM or thumb drive.
  - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
  - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.

4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
  - a. Name of Contractor/Installer.
  - b. Business address.
  - c. Business phone number.
  - d. Point of contact.
  - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
  1. Film training session(s) in segments not to exceed 15 minutes.
    - a. Produce segments to present a single significant piece of equipment per segment.
    - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
  1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

END OF SECTION 017900

## SECTION 018113.43 - SUSTAINABLE DESIGN REQUIREMENTS - ASHRAE 189.1

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes general requirements and procedures for compliance with certain requirements of ASHRAE 189.1, "Standard for the Design of High-Performance Green Buildings - except Low-Rise Residential Buildings."
  - 1. Other ASHRAE 189.1 requirements depend on product selections and may not be specifically identified as ASHRAE 189.1 requirements. Compliance with ASHRAE 189.1 requirements will be used as one criterion to evaluate substitution requests and comparable product requests.
  - 2. Specific ASHRAE 189.1 requirements are also included in other Sections.

#### 1.3 DEFINITIONS

- A. ASHRAE 189.1: ASHRAE/USGBC/IES 189.1.
  - 1. Definitions that are a part of ASHRAE 189.1 apply to this Section.
- B. Regional Materials: Materials and products that are manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 in determining the distance to Project site. If only a portion of a material or product complies with this requirement, only that portion, by weight, shall be considered regional.
- C. Biobased Products: Products that comply with the USDA's Designation of Biobased Items for Federal Procurement, contain the "USDA Certified Biobased Product" label, or be composed of solid wood, engineered wood, bamboo, wool, cotton, cork, agricultural fibers, or other biobased materials with at least 50 percent biobased content.
  - 1. Wood components used to comply with this requirement shall contain not less than 60 percent certified wood tracked through a chain-of-custody process. Certification shall be by a forest certification system with principles, criteria, and standards developed using ISO/TEC Guide 59 or the WTO Agreement on Technical Barriers to Trade.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site** Review ASHRAE 189.1 requirements and action plans for compliance with requirements.

#### 1.5 ADMINISTRATIVE REQUIREMENTS

- A. Respond to questions and requests from Architect about ASHRAE 189.1 requirements that are the responsibility of Contractor, that depend on product selection or product qualities, or that depend on Contractor's procedures. Document responses as informational submittals.

#### 1.6 ACTION SUBMITTALS

- A. General: Submit additional sustainable design submittals required by other Specification Sections.
- B. Sustainable design submittals are in addition to other submittals.
  - 1. If submitted item is identical to that submitted to comply with other requirements, include an additional copy with other submittal as a record copy of compliance with indicated ASHRAE 189.1 requirements instead of separate sustainable design submittal. Mark additional copy "Sustainable design submittal."
- C. ASHRAE 189.1 Documentation Submittals:
  - 1. Recycled Materials: Product Data and certification letter from product manufacturers indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating cost.
  - 2. Regional Materials: Product Data indicating location of material manufacturer and point of extraction, harvest, or recovery for raw materials. Include statement indicating distances from Project site, modes of transportation, and cost.
  - 3. Biobased Products: Product Data and certification indicating biobased content. Include chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
  - 4. Construction Waste Management: Comply with Section 017419 "Construction Waste Management and Disposal."
  - 5. Indoor Air Quality during Construction:
    - a. Construction indoor-air-quality management plan.
    - b. Product Data for temporary filtration media.
    - c. Product Data for filtration media used during occupancy.
  - 6. Material Emissions and Pollutant Control: Product Data for the following indicating compliance with requirements.
    - a. Adhesives and sealants.
    - b. Paints and coatings.

- c. Floor covering materials.
- d. Composite wood products.
- e. Ceiling and wall systems.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
  - 1. Mechanical.
  - 2. Electrical.
  - 3. Plumbing.
  - 4. Fire safety systems.
  - 5. Transportation devices.
  - 6. Piping.
  - 7. Plumbing fixtures.
  - 8. Ductwork.
  - 9. Conduit.
  - 10. Wiring.
  - 11. Cabling.
  - 12. Elevator and escalator framing.
- B. Action Plans: Submit the following action plans within **30** days of date established for **the Notice to Proceed** indicating how requirements will be met.
  - 1. List of proposed materials with recycled content. Indicate cost, postconsumer recycled content, and preconsumer recycled content for each product having recycled content.
  - 2. List of proposed regional materials.
  - 3. List of proposed biobased products.
  - 4. Waste management plan complying with Section 017419 "Construction Waste Management and Disposal."
  - 5. Construction indoor-air-quality management plan.
- C. Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction activities with action plans.
- D. Indoor-air-quality test report.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to comply with requirements in this Section for material selection and material emissions and pollutant control. Although other Sections may specify some requirements for material selection and material emissions and pollutant control,

Contractor shall provide additional materials and procedures necessary to comply with requirements.

## 2.2 MATERIAL SELECTION

- A. Recycled Content: Building materials shall have recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content for Project constitutes a minimum of 10 percent of cost of materials used for Project.
  - 1. Cost of postconsumer recycled content plus one-half of preconsumer recycled content of an item shall be determined by dividing weight of postconsumer recycled content plus one-half of preconsumer recycled content in the item by total weight of the item and multiplying by cost of the item.
  - 2. Do not include components of mechanical, electrical, plumbing, and fire safety systems and transportation devices other than piping, plumbing fixtures, ductwork, conduit, wiring, cabling, and elevator and escalator framing in the calculation.
- B. Regional Materials: Not less than 15 percent of building materials, based on cost, shall be regional materials.
- C. Biobased Products: Not less than 5 percent of building materials, based on cost, shall be biobased materials.

## 2.3 MATERIAL EMISSIONS AND POLLUTANT CONTROL

- A. Adhesives and Sealants: Field-applied adhesives and sealants that are inside the weatherproofing system shall comply with either of the following:
  - 1. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  - 2. VOC content shall not exceed limits of authorities having jurisdiction and the following:
    - a. Wood Glues: 30 g/L.
    - b. Metal-to-Metal Adhesives: 30 g/L.
    - c. Adhesives for Porous Materials (except Wood): 50 g/L.
    - d. Subfloor Adhesives: 50 g/L.
    - e. Plastic Foam Adhesives: 50 g/L.
    - f. Carpet Adhesives: 50 g/L.
    - g. Carpet Pad Adhesives: 50 g/L.
    - h. VCT and Asphalt Tile Adhesives: 50 g/L.
    - i. Cove Base Adhesives: 50 g/L.
    - j. Gypsum Board and Panel Adhesives: 50 g/L.
    - k. Rubber Floor Adhesives: 60 g/L.
    - l. Ceramic Tile Adhesives: 65 g/L.
    - m. Multipurpose Construction Adhesives: 70 g/L.

- n. Fiberglass Adhesives: 80 g/L.
- o. Contact Adhesive: 80 g/L.
- p. Structural Glazing Adhesives: 100 g/L.
- q. Wood Flooring Adhesive: 100 g/L.
- r. Structural Wood Member Adhesive: 140 g/L.
- s. Single-Ply Roof Membrane Adhesive: 250 g/L.
- t. Special-Purpose Contact Adhesive (Contact Adhesive That Is Used to Bond Melamine Covered Board, Metal, Unsupported Vinyl, Rubber, or Wood Veneer 1/16 Inch or Less in Thickness to Any Surface): 250 g/L.
- u. Top and Trim Adhesive: 250 g/L.
- v. Plastic Cement Welding Compounds: 250 g/L.
- w. ABS Welding Compounds: 325 g/L.
- x. CPVC Welding Compounds: 490 g/L.
- y. PVC Welding Compounds: 510 g/L.
- z. Adhesive Primer for Plastic: 550 g/L.
- aa. Sheet-Applied Rubber Lining Adhesive: 850 g/L.
- bb. Aerosol Adhesive, General-Purpose Mist Spray: 65 percent by weight.
- cc. Aerosol Adhesive, General-Purpose Web Spray: 55 percent by weight.
- dd. Special-Purpose Aerosol Adhesive (All Types): 70 percent by weight.
- ee. Other Adhesives: 250 g/L.
- ff. Architectural Sealants: 250 g/L.
- gg. Nonmembrane Roof Sealants: 300 g/L.
- hh. Single-Ply Roof Membrane Sealants: 450 g/L.
- ii. HVAC Duct Sealants: 420 g/L.
- jj. Other Sealants: 420 g/L.
- kk. Sealant Primers for Nonporous Substrates: 250 g/L.
- ll. Sealant Primers for Porous Substrates: 775 g/L.
- mm. Modified Bituminous Sealant Primers: 500 g/L.
- nn. Other Sealant Primers: 750 g/L.

B. Paints and Coatings: Field-applied paints and coatings that are inside the weatherproofing system shall comply with either of the following:

- 1. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- 2. VOC content shall not exceed limits of authorities having jurisdiction and the following:
  - a. Flat Coatings: 50 g/L.
  - b. Nonflat Coatings: 100 g/L.
  - c. Primers, Sealers, and Undercoats: 100 g/L.
  - d. Floor Coatings: 100 g/L.
  - e. Shellacs, Clear: 730 g/L.
  - f. Shellacs, Pigmented: 550 g/L.
  - g. Stains: 250 g/L.
  - h. Clear Wood Finishes (Varnishes, Sanding Sealers, and Lacquers): 275 g/L.

- C. Floor covering materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Composite wood products, including particleboard, medium-density fiberboard, straw-based particleboard, panel substrates, and door cores, used inside the weatherproofing system shall be made without urea formaldehyde and shall comply with either of the following:
  - 1. Third-party certification acceptable to the California Air Resources Board indicating compliance with its regulation "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products."
  - 2. Requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. Ceiling and Wall Systems: Ceiling and wall insulation, acoustic ceiling panels, tackable wall panels, gypsum board, and wall coverings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

### PART 3 - EXECUTION

#### 3.1 NONSMOKING BUILDING

- A. Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

#### 3.2 CONSTRUCTION WASTE MANAGEMENT

- A. Comply with Section 017419 "Construction Waste Management and Disposal."

#### 3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. Comply with ASHREA 62.1, Ch. 7.
- B. If Owner authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Section 015000 "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
  - 1. Replace air filters immediately prior to occupancy.
- C. Air-Quality Testing: **Contractor to engage** testing agency to perform the following:



1. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Toxic Organic Pollutants in Ambient Air," Sections TO-1, TO-11, and TO-17; and ASTM D5197. The number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area.
2. Concentrations of the following shall not exceed:
  - a. Particulates (PM<sub>2.5</sub>): 35 mcg/cu. m. (24 hours).
  - b. Particulates (PM<sub>10</sub>): 150 mcg/cu. m. (24 hours).
  - c. Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
  - d. Ozone: 0.075 ppm (8 hours).
  - e. Acetaldehyde: 140 mcg/cu. m.
  - f. Acrylonitrile: 5 mcg/cu. m.
  - g. Benzene: 60 mcg/cu. m.
  - h. 1, 3-Butadiene: 20 mcg/cu. m.
  - i. t-Butyl Methyl Ether: 8000 mcg/cu. m.
  - j. Carbon Disulfide: 800 mcg/cu. m.
  - k. Carbon Tetrachloride: 40 mcg/cu. m.
  - l. Chlorobenzene: 1000 mcg/cu. m.
  - m. Chloroform: 300 mcg/cu. m.
  - n. 1, 4-Dichlorobenzene: 800 mcg/cu. m.
  - o. Dichloromethene (Methylene Chloride): 400 mcg/cu. m.
  - p. 1, 4-Dioxane: 3000 mcg/cu. m.
  - q. Ethylbenzene: 2000 mcg/cu. m.
  - r. Ethylene Glycol: 400 mcg/cu. m.
  - s. Formaldehyde: 27 mcg/cu. m.
  - t. n-Hexane: 7000 mcg/cu. m.
  - u. Naphthalene: 9 mcg/cu. m.
  - v. Phenol: 200 mcg/cu. m.
  - w. 2-Propanol (Isopropanol): 7000 mcg/cu. m.
  - x. Styrene: 900 mcg/cu. m.
  - y. Tetrachloroethane (Tetrachloroethylene, Parachloroethylene): 35 mcg/cu. m.
  - z. Toluene: 300 mcg/cu. m.
  - aa. 1, 1, 1-Trichloroethane (Methyl Chloroform): 1000 mcg/cu. m.
  - bb. Trichloroethane (Trichloroethylene): 600 mcg/cu. m.
  - cc. Xylene Isomers: 700 mcg/cu. m.
3. Where carpets and fabrics with styrene butadiene rubber latex backing are installed, concentrations of the following shall not exceed:
  - a. Caprolactam: 100 mcg/cu. m.
  - b. 2-Ethylhexanoic Acid: 25 mcg/cu. m.
  - c. 1-Methyl-2-Pyrrolidinone: 160 mcg/cu. m.
  - d. Nonanal: 13 mcg/cu. m.
  - e. Octanal: 7.2 mcg/cu. m.
  - f. 4-Phenylcyclohexene (4-PH): 2.5 mcg/cu. m.
4. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to

indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.

END OF SECTION 018113.43

## SECTION 019113 - GENERAL COMMISSIONING REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. Owner's Project Requirements and Basis-of-Design Document are included by reference for information only.

#### 1.2 SUMMARY

A. Section Includes:

- 1. General requirements for coordinating and scheduling commissioning activities.
- 2. Commissioning meetings.
- 3. Commissioning reports.
- 4. Use of commissioning process test equipment, instrumentation, and tools.
- 5. Construction checklists, including, but not limited to, installation checks, startup, performance tests, and performance test demonstration.
- 6. Commissioning tests and commissioning test demonstration.
- 7. Adjusting, verifying, and documenting identified systems and assemblies.

B. Related Requirements:

- 1. Section 011000 "Summary" for Commissioning Authority responsibilities.
- 2. Section 013300 "Submittal Procedures" for submittal procedure requirements for commissioning process.
- 3. Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
- 4. Section 017823 "Operation and Maintenance Data" for preliminary operation and maintenance data submittal requirements.
- 5. Section 019119.43 "Exterior Enclosure Commissioning" for technical commissioning requirements for exterior closure.
- 6. Section 230800 "Commissioning of HVAC" for technical commissioning requirements for HVAC.
- 7. Section 260800 "Commissioning of Electrical Systems" for technical commissioning requirements for electrical systems.

### 1.3 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- B. Basis-of-Design Document: A document prepared by Architect that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.
- C. Commissioning Authority: An entity engaged by Owner, and identified in Section 011000 "Summary," to evaluate Commissioning-Process Work.
- D. Commissioning Plan: A document, prepared by Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation of commissioning requirements.
- E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities. The scope of the commissioning process is defined in Section 011000 "Summary."
- F. Construction-Phase Commissioning-Process Completion: The stage of completion and acceptance of commissioning process when resolution of deficient conditions and issues discovered during commissioning process and retesting until acceptable results are obtained has been accomplished. Owner will establish in writing the date construction-phase commissioning-process completion is achieved. See Section 017700 "Closeout Procedures" for Certificate of Construction-Phase Commissioning Process Completion submittal requirements.
  - 1. Commissioning process is complete when the Work specified of this Section and related Sections has been completed and accepted, including, but not limited to, the following:
    - a. Completion of tests and acceptance of test results.
    - b. Resolution of issues, as verified by retests performed and documented with acceptance of retest results.
    - c. Comply with requirements in Section 017900 "Demonstration and Training."
    - d. Completion and acceptance of submittals and reports.
- G. Owner's Project Requirements: A document that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This document is prepared either by the Owner or for the Owner by the Architect or Commissioning Authority.
- H. Owner's Witness: Commissioning Authority, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.

- I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- J. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- K. Sampling Procedures and Tables for Inspection by Attributes: As defined in ASQ Z1.4.

#### 1.4 COMPENSATION

- A. If Architect, Commissioning Authority, other Owner's witness, or Owner's staff perform additional services or incur additional expenses due to actions of Contractor listed below, compensate Owner for such additional services and expenses.
  - 1. Failure to provide timely notice of commissioning activities schedule changes.
  - 2. Failure to meet acceptance criteria for test demonstrations.

#### 1.5 COMMISSIONING TEAM

- A. Members Appointed by Contractor(s):
  - 1. Commissioning Coordinator: A person or entity employed by Contractor to manage, schedule, and coordinate commissioning process.
  - 2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning process.
  - 3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning process.
  - 4. Appointed team members shall have the authority to act on behalf of the entity they represent.
- B. Members Appointed by Owner:
  - 1. Commissioning Authority, plus consultants that Commissioning Authority may deem appropriate for a particular portion of the commissioning process.
  - 2. Owner representative(s), facility operations and maintenance personnel, plus other employees, separate contractors, and consultants that Owner may deem appropriate for a particular portion of the commissioning process.
  - 3. Architect, plus employees and consultants that Architect may deem appropriate for a particular portion of the commissioning process.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Comply with requirements in Section 013300 "Submittal Procedures" for submittal procedure general requirements for commissioning process.

B. Commissioning Plan Information:

1. List of Contractor-appointed commissioning team members to include specific personnel and subcontractors performing the various commissioning requirements.
2. Schedule of commissioning activities, integrated with the Construction Schedule. Comply with requirements in Section 013200 "Construction Progress Documentation" for the Construction Schedule general requirements for commissioning process.
3. Contractor personnel and subcontractors participating in each test.
4. List of instrumentation required for each test to include identification of parties that will provide instrumentation for each test.

C. Commissioning schedule.

D. Two-week look-ahead schedules.

E. Commissioning Coordinator Letter of Authority:

1. Within 10 days after approval of Commissioning Coordinator qualifications, submit a letter of authority for Commissioning Coordinator, signed by a principal of Contractor's firm. Letter shall authorize Commissioning Coordinator to do the following:
  - a. Make inspections required for commissioning process.
  - b. Coordinate, schedule, and manage commissioning process of Contractor, subcontractors, and suppliers.
  - c. Obtain documentation required for commissioning process from Contractor, subcontractors, and suppliers.
  - d. Report issues, delayed resolution of issues, schedule conflicts, and lack of cooperation or expertise on the part of members of the commissioning team.

F. Commissioning Coordinator Qualification Data: For entity coordinating Contractor's commissioning activities to demonstrate their capabilities and experience.

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

G. List test instrumentation, equipment, and monitoring devices. Include the following information:

1. Make, model, serial number, and application for each instrument, equipment, and monitoring device.
2. Brief description of intended use.
3. Calibration record showing the following:
  - a. Calibration agency, including name and contact information.
  - b. Last date of calibration.
  - c. Range of values for which calibration is valid.
  - d. Certification of accuracy.

- e. Certification for calibration equipment traceable to NIST.
- f. Due date of the next calibration.

H. Test Reports:

- 1. Pre-Startup Report: Prior to startup of equipment or a system, submit signed, completed construction checklists.
- 2. Test Data Reports: At the end of each day in which tests are conducted, submit test data for tests performed.
- 3. Commissioning Issue Reports: Daily, at the end of each day in which tests are conducted, submit commissioning issue reports for tests for which acceptable results were not achieved.
- 4. Weekly Progress Report: Weekly, at the end of each week in which tests are conducted, submit a progress report.
- 5. Data Trend Logs: Submit data trend logs at the end of the trend log period.
- 6. System Alarm Logs: Daily, at the start of days following a day in which tests were performed, submit printout of log of alarms that occurred since the last log was printed.

I. Construction Checklists:

- 1. Material checks.
- 2. Installation checks.
- 3. Startup procedures, where required.

1.7 CLOSEOUT SUBMITTALS

A. Commissioning Report:

- 1. At Construction-Phase Commissioning Completion, include the following:
  - a. Pre-startup reports.
  - b. Approved test procedures.
  - c. Test data forms, completed and signed.
  - d. Progress reports.
  - e. Commissioning issue report log.
  - f. Commissioning issue reports showing resolution of issues.
  - g. Correspondence or other documents related to resolution of issues.
  - h. Other reports required by commissioning process.
  - i. List unresolved issues and reasons they remain unresolved and should be exempted from the requirements for Construction-Phase Commissioning Completion.
  - j. Report shall include commissioning work of Contractor.

B. Request for Certificate of Construction-Phase Commissioning Process Completion.

C. Operation and Maintenance Data: For proprietary test equipment, instrumentation, and tools to include in operation and maintenance manuals.

## 1.8 QUALITY ASSURANCE

### A. Commissioning Coordinator Qualifications:

1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least three projects of similar scope and complexity.
2. Certification of commissioning-process expertise. The following certifications are acceptable. Owner reserves the right to accept or reject certifications as evidence of qualification.
  - a. Certified Commissioning Authority, by AABC Commissioning Group (ACG).
  - b. Commissioning-Process Management Professional, by American Society of Heating, Refrigerating and Air-Conditioning Engineers.
  - c. Certified Commissioning Professional, by Building Commissioning Association.
  - d. Accredited Commissioning-Process Authority Professional, by University of Wisconsin.
  - e. Accredited Commissioning-Process Manager, by University of Wisconsin.
  - f. Accredited Green Commissioning-Process Provider, by University of Wisconsin.

### B. Calibration Agency Qualifications: Certified by The American Association for Laboratory Accreditation that the calibration agency complies with minimum requirements of ISO/IEC 17025.

## PART 2 - PRODUCTS

### 2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Test equipment and instrumentation required to perform the commissioning process shall remain the property of Contractor unless otherwise indicated.
- B. Test equipment and instrumentation required to perform commissioning process shall comply with the following criteria:
  1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
  2. Calibrated and certified.
    - a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags shall be permanently affixed.
    - b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.



3. Maintain test equipment and instrumentation.
4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

## 2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.
1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
  2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Final Acceptance.

## 2.3 REPORT FORMAT AND ORGANIZATION

A. General Format and Organization:

1. Bind report in three-ring binders.
2. Label the front cover and spine of each binder with the report title, volume number, project name, Contractor's name, and date of report.
3. Record report on compact disk.
4. Electronic Data: Portable document format (PDF); a single file with outline-organized bookmarks for major and minor tabs and tab contents itemized for specific reports.

B. Commissioning Report:

1. Include a table of contents and an index to each test.
2. Include major tabs for each Specification Section.
3. Include minor tabs for each test.
4. Within each minor tab, include the following:
  - a. Test specification.
  - b. Pre-startup reports.
  - c. Approved test procedures.
  - d. Test data forms, completed and signed.
  - e. Commissioning issue reports, showing resolution of issues, and documentation related to resolution of issues pertaining to a single test. Group data forms, commissioning issue reports showing resolution of issues, and documentation related to resolution of issues for each test repetition together within the minor tab, in reverse chronological order (most recent on top).

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Review preliminary construction checklists and preliminary test procedures and data forms.

### 3.2 CONSTRUCTION CHECKLISTS

- A. Construction checklists cannot modify or conflict with the Contract Documents.
- B. Create construction checklists based on actual systems and equipment to be included in Project.
- C. Material Checks: Compare specified characteristics and approved submittals with materials as received. Include factory tests and other evaluations, adjustments, and tests performed prior to shipment if applicable.
  - 1. Service connection requirements, including configuration, size, location, and other pertinent characteristics.
  - 2. Included optional features.
  - 3. Delivery Receipt Check: Inspect and record physical condition of materials and equipment on delivery to Project site, including agreement with approved submittals, cleanliness, and lack of damage.
  - 4. Installation Checks:
    - a. Location according to Drawings and approved Shop Drawings.
    - b. Configuration.
    - c. Compliance with manufacturers' written installation instructions.
    - d. Attachment to structure.
    - e. Access clearance to allow for maintenance, service, repair, removal, and replacement without the need to disassemble or remove other equipment or building elements. Access coordinated with other building elements and equipment, including, but not limited to, ceiling and wall access panels, in a manner consistent with OSHA fall-protection regulations and safe work practices.
    - f. Utility connections are of the correct characteristics, as applicable.
    - g. Correct labeling and identification.
    - h. Startup Checks: Verify readiness of equipment to be energized. Include manufacturer's standard startup procedures and forms.
- D. Startup: Perform and document initial operation of equipment to prove that it is installed properly and operates as intended according to manufacturer's standard startup procedures, at minimum.
- E. Performance Tests:
  - 1. Static Tests: As specified elsewhere, including, but not limited to, duct and pipe leakage tests, insulation-resistance tests, and water-penetration tests.

2. Component Performance Tests: Tests evaluate the performance of an input or output of components under a full range of operating conditions.
  3. Equipment and Assembly Performance Tests: Test and evaluate performance of equipment and assemblies under a full range of operating conditions and loads.
  4. System Performance Tests: Test and evaluate performance of systems under a full range of operating conditions and loads.
  5. Intersystem Performance Tests: Test and evaluate the interface of different systems under a full range of operating conditions and loads.
- F. Deferred Construction Checklists: Obtain Owner approval of proposed deferral of construction checklists, including proposed schedule of completion of each deferred construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, deferred construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:
1. Identify deferred construction checklists by number and title.
  2. Provide a target schedule for completion of deferred construction checklists.
  3. Written approval of proposed deferred construction checklists, including approved schedule of completion of each deferred construction checklist.
- G. Delayed Construction Checklists: Obtain Owner approval of proposed delayed construction checklists, including proposed schedule of completion of each delayed construction checklist, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. When approved, delayed construction checklists may be completed after date of Construction-Phase Commissioning Completion. Include the following in a request for Certificate of Construction-Phase Commissioning Process Completion:
1. Identify delayed construction checklist by construction checklist number and title.
  2. Provide a target schedule for completion of delayed construction checklists.
  3. Written approval of proposed delayed construction checklists, including approved schedule of completion of each delayed construction checklist.

### 3.3 GENERAL EXECUTION REQUIREMENTS

- A. Schedule and coordinate commissioning process with the Construction Schedule.
- B. Perform activities identified in construction checklists, including tests, and document results of actions as construction proceeds.
- C. Perform test demonstrations for Owner's witness. Unless otherwise indicated, demonstrate tests for 100 percent of work to which the test applies. In some instances, demonstration of a random sample of other than 100 percent of the results of a test is specified.
  1. Where sampling is specified, the sampling plan and procedure for the test demonstration shall be determined using ASQ Z1.4.
    - a. General Inspection: [Level I] [Level II] [Level III]

- b. Special Inspection: [Level S-1] [Level S-2] [Level S-3] [Level S-4]
  - c. Acceptance Quality Limit (AQL) of 1.5
- 2. The "lot size" in ASQ Z1.4 is the sum of the number of items to which the test demonstration applies, as described in the scope subparagraph of each test.
  - 3. On determination of the sample size, the samples shall be selected randomly by Owner's witness at the time of the test demonstration.
  - 4. Include in the Commissioning Plan a detailed list of the test demonstrations with lot and sample quantities for each test.
- D. Report test data and commissioning issue resolutions.
- E. Schedule personnel to participate in and perform Commissioning-Process Work.
- F. Installing contractors' commissioning responsibilities include, but are not limited to, the following:
- 1. Operating the equipment and systems they install during tests.
  - 2. In addition, installing contractors may be required to assist in tests of equipment and systems with which their work interfaces.

### 3.4 COMMISSIONING COORDINATOR RESPONSIBILITIES

- A. Management and Coordination: Manage, schedule, and coordinate commissioning process, including, but not limited to, the following:
- 1. Coordinate with subcontractors on their commissioning responsibilities and activities.
  - 2. Obtain, assemble, and submit commissioning documentation.
  - 3. Attend periodic on-site commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."
  - 4. Develop and maintain the commissioning schedule. Integrate commissioning schedule into the Construction Schedule. Update Construction Schedule at specified intervals.
  - 5. Review and comment on preliminary test procedures and data forms.
  - 6. Report inconsistencies and issues in system operations.
  - 7. Verify that tests have been completed and results comply with acceptance criteria, and that equipment and systems are ready before scheduling test demonstrations.
  - 8. Direct and coordinate test demonstrations.
  - 9. Coordinate witnessing of test demonstrations by Owner's witness.
  - 10. Coordinate and manage training. Be present during training sessions to direct video recording, present training, and direct the training presentations of others. Comply with requirements in Section 017900 "Demonstration and Training."
  - 11. Prepare and submit specified commissioning reports.
  - 12. Track commissioning issues until resolution and retesting is successfully completed.
  - 13. Retain original records of Commissioning-Process Work, organized as required for the commissioning report. Provide Owner's representative access to these records on request.
  - 14. Assemble and submit commissioning report.

### 3.5 COMMISSIONING TESTING

- A. Quality Control: Construction checklists, including tests, are quality-control tools designed to improve the functional quality of Project. Test demonstrations evaluate the effectiveness of Contractor's quality-control process.
- B. Owner's witness will be present to witness commissioning work requiring the signature of an owner's witness, including, but not limited to, test demonstrations. Owner's project manager will coordinate attendance by Owner's witness with Contractor's published Commissioning Schedule. Owner's witness will provide no labor or materials in the commissioning work. The only function of Owner's witness will be to observe and comment on the progress and results of commissioning process.
- C. Construction Checklists:
  - 1. Complete construction checklists as Work is completed.
  - 2. Distribute construction checklists to installing contractors before they start work.
  - 3. Installers:
    - a. Verify installation using approved construction checklists as Work proceeds.
    - b. Complete and sign construction checklists daily for work performed during the preceding day.
  - 4. Provide Commissioning Authority access to construction checklists.
- D. Installation Compliance Issues: Record as an installation compliance issue Work found to be incomplete, inaccessible, at variance with the Contract Documents, nonfunctional, or that does not comply with construction checklists. Record installation compliance issues on the construction checklist at the time they are identified. Record corrective action and how future Work should be modified before signing off the construction checklist.
- E. Pre-Startup Audit: Prior to executing startup procedures, review completed installation checks to determine readiness for startup and operation. Report conditions, which, if left uncorrected, adversely impact the ability of systems or equipment to operate satisfactorily or to comply with acceptance criteria. Prepare pre-startup report for each system.
- F. Test Procedures and Test Data Forms:
  - 1. Test procedures shall define the step-by-step procedures to be used to execute tests and test demonstrations.
  - 2. Test procedures shall be specific to the make, model, and application of the equipment and systems being tested.
  - 3. Completed test data forms are the official records of the test results.
  - 4. Commissioning Authority will provide to Contractor preliminary test procedures and test data forms for performance tests and commissioning tests after approval of Product Data, Shop Drawings, and preliminary operation and maintenance manual.
  - 5. Review preliminary test procedures and test data forms, and provide comments within 14 days of receipt from Commissioning Authority. Review shall address the following:

- a. Equipment protection and warranty issues, including, but not limited to, manufacturers' installation and startup recommendations, and operation and maintenance instructions.
  - b. Applicability of the procedure to the specific software, equipment, and systems approved for installation.
6. After Contractor has reviewed and commented on the preliminary test procedures and test data forms, Commissioning Authority will revise and reissue the approved revised test procedures and test data forms marked "Approved for Testing."
7. Use only approved test procedures and test data forms marked "Approved for Testing" to perform and document tests and test demonstrations.

G. Performance of Tests:

1. The sampling rate for tests is 100 percent. The sampling rate for test demonstrations is 100 percent unless otherwise indicated.
2. Perform and complete each step of the approved test procedures in the order listed.
3. Record data observed during performance of tests on approved data forms at the time of test performance and when the results are observed.
4. Record test results that are not within the range of acceptable results on commissioning issue report forms in addition to recording the results on approved test procedures and data forms according to the "Commissioning Compliance Issues" Paragraph in this Article.
5. On completion of a test, sign the completed test procedure and data form. Tests for which test procedures and data forms are incomplete, not signed, or which indicate performance that does not comply with acceptance criteria will be rejected. Tests for which test procedures and data forms are rejected shall be repeated and results resubmitted.

H. Performance of Test Demonstration:

1. Perform test demonstrations on a sample of tests after test data submittals are approved. The sampling rate for test demonstrations shall be 100 percent unless otherwise indicated in the individual test specification.
2. Notify Owner's witness at least three days in advance of each test demonstration.
3. Perform and complete each step of the approved test procedures in the order listed.
4. Record data observed during performance of test demonstrations on approved data forms at the time of demonstration and when the results are observed.
5. Provide full access to Owner's witness to directly observe the performance of all aspects of system response during the test demonstration. On completion of a test demonstration, sign the completed data form and obtain signature of Owner's witness at the time of the test to authenticate the reported results.
6. Test demonstration data forms not signed by Contractor and Owner's witness at the time of the completion of the procedure will be rejected. Test demonstrations for which data forms are rejected shall be repeated and results shall be resubmitted.
  - a. Exception for Failure of Owner's Witness to Attend: Failure of Owner's witness to be present for agreed-on schedule of test demonstration shall not delay Contractor. If Owner's witness fails to attend a scheduled test, Contractor shall proceed with the scheduled test. On completion, Contractor shall sign the data form for

Contractor and for Owner's witness, and shall note the absence of Owner's witness at the scheduled time and place.

7. False load test requirements are specified in related sections.
  - a. Where false load testing is specified, provide temporary equipment, power, controls, wiring, piping, valves, and other necessary equipment and connections required to apply the specified load to the system. False load system shall be capable of steady-state operation and modulation at the level of load specified. Equipment and systems permanently installed in this work shall not be used to create the false load without Architect's written approval.

I. Deferred Tests:

1. Deferred Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed deferred tests or other tests approved for deferral until specified seasonal or other conditions are available. When approved, deferred tests may be completed after the date of Construction-Phase Commissioning Completion. Identify proposed deferred tests in the request for Certificate of Construction-Phase Commissioning Process Completion as follows:
  - a. Identify deferred tests by number and title.
  - b. Provide a target schedule for completion of deferred tests.
2. Schedule and coordinate deferred tests. Schedule deferred tests when specified conditions are available. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.
3. Where deferred tests are specified, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule deferred tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

J. Delayed Tests:

1. Delayed Test List: Identify, in the request for Certificate of Construction-Phase Commissioning Process Completion, proposed delayed tests. Obtain Owner approval of proposed delayed tests, including proposed schedule of completion of each delayed test, before submitting request for Certificate of Construction-Phase Commissioning Process Completion. Include the following in the request for Certificate of Construction-Phase Commissioning Process Completion:
  - a. Identify delayed tests by test number and title.
  - b. Written approval of proposed delayed tests, including approved schedule of completion of delayed tests.
2. Schedule and coordinate delayed tests. Schedule delayed tests when conditions that caused the delay have been rectified. Notify Architect and Commissioning Authority at least three working days (minimum) in advance of tests.

3. Where delayed tests are approved, coordinate participation of necessary personnel and of Architect, Commissioning Authority, and Owner's witness. Schedule delayed tests to minimize occupant and facility impact. Obtain Architect's approval of the proposed schedule.

K. Commissioning Compliance Issues:

1. Test results that are not within the range of acceptable results are commissioning compliance issues.
2. Track and report commissioning compliance issues until resolution and retesting are successfully completed.
3. If a test demonstration fails, determine the cause of failure. Direct timely resolution of issue and then repeat the demonstration. If a test demonstration must be repeated due to failure caused by Contractor work or materials, reimburse Owner for billed costs for the participation in the repeated demonstration.
4. Test Results: If a test demonstration fails to meet the acceptance criteria, perform the following:
  - a. Complete a commissioning compliance issue report form promptly on discovery of test results that do not comply with acceptance criteria.
  - b. Submit commissioning compliance issue report form within 24 hours of the test.
  - c. Determine the cause of the failure.
  - d. Establish responsibility for corrective action if the failure is due to conditions found to be Contractor's responsibility.
5. Commissioning Compliance Issue Report: Provide a commissioning compliance issue report for each issue. Do not report multiple issues on the same commissioning compliance issue report.
  - a. Exception: If an entire class of devices is determined to exhibit the identical issue, they may be reported on a single commissioning compliance issue report. (For example, if all return-air damper actuators that are specified to fail to the open position are found to fail to the closed position, they may be reported on a single commissioning issue report. If a single commissioning issue report is used for multiple commissioning compliance issues, each device shall be identified in the report, and the total number of devices at issue shall be identified.
  - b. Complete and submit Part 1 of the commissioning compliance issue report immediately when the condition is observed.
  - c. Record the commissioning compliance issue report number and describe the deficient condition on the data form.
  - d. Resolve commissioning compliance issues promptly. Complete and submit Part 2 of the commissioning compliance issue report when issues are resolved.
6. Diagnose and correct failed test demonstrations as follows:
  - a. Perform diagnostic tests and activities required to determine the fundamental cause of issues observed.
  - b. Record each step of the diagnostic procedure prior to performing the procedure. Update written procedure as changes become necessary.



- c. Record the results of each step of the diagnostic procedure.
  - d. Record the conclusion of the diagnostic procedure on the fundamental cause of the issue.
  - e. Determine and record corrective measures.
  - f. Include diagnosis of fundamental cause of issues in commissioning compliance issue report.
- 7. Retest:
  - a. Schedule and repeat the complete test procedure for each test demonstration for which acceptable results are not achieved. Obtain signature of Owner's witness on retest data forms. Repeat test demonstration until acceptable results are achieved. Except for issues that are determined to result from design errors or omissions, or other conditions beyond Contractor's responsibility, compensate Owner for direct costs incurred as the result of repeated test demonstrations to achieve acceptable results.
  - b. For each repeated test demonstration, submit a new test data form, marked "Retest."
- 8. Do not correct commissioning compliance issues during test demonstrations.
  - a. Exceptions will be allowed if the cause of the issue is obvious and resolution can be completed in less than five minutes. If corrections are made under this exception, note the deficient conditions on the test data form and issue a commissioning compliance issue report. A new test data form, marked "Retest," shall be initiated after the resolution has been completed.

### 3.6 COMMISSIONING MEETINGS

- A. Commissioning Authority will schedule and conduct commissioning meetings. Comply with requirements in Section 013100 "Project Management and Coordination."

### 3.7 SEQUENCING

- A. Sequencing of Commissioning Verification Activities: For a particular material, item of equipment, assembly, or system, perform the following in the order listed unless otherwise indicated:
  - 1. Construction Checklists:
    - a. Material checks.
    - b. Installation checks.
    - c. Startup, as appropriate. Some startup may depend on component performance. Such startup may follow component performance tests on which the startup depends.
    - d. Performance Tests:

- 1) Static tests, as appropriate.
  - 2) Component performance tests. Some component performance tests may depend on completion of startup. Such component performance tests may follow startup.
  - 3) Equipment and assembly performance tests.
  - 4) System performance tests.
  - 5) Intersystem performance tests.
2. Commissioning tests.
- B. Before performing commissioning tests, verify that materials, equipment, assemblies, and systems are delivered, installed, started, and adjusted to perform according to construction checklists.
- C. Verify readiness of materials, equipment, assemblies, and systems by performing tests prior to performing test demonstrations. Notify Architect if acceptable results cannot be achieved due to conditions beyond Contractor's control or responsibility.
- D. Commence tests as soon as installation checks for materials, equipment, assemblies, or systems are satisfactorily completed. Tests of a particular system may proceed prior to completion of other systems, provided the incomplete work does not interfere with successful execution of test.

### 3.8 SCHEDULING

- A. Commence commissioning process as early in the construction period as possible.
- B. Commissioning Schedule: Integrate commissioning activities into Construction Schedule. See Section 013200 "Construction Progress Documentation."
1. Include detailed commissioning activities in monthly updated Construction Schedule and short-interval schedule submittals.
  2. Schedule the start date and duration for the following commissioning activities:
    - a. Submittals.
    - b. Preliminary operation and maintenance manual submittals.
    - c. Installation checks.
    - d. Startup, where required.
    - e. Performance tests.
    - f. Performance test demonstrations.
    - g. Commissioning tests.
    - h. Commissioning test demonstrations.
  3. Schedule shall include a line item for each installation check, startup, and test activity specific to the equipment or systems involved.
  4. Determine milestones and prerequisites for commissioning process. Show commissioning milestones, prerequisites, and dependencies in monthly updated critical-path-method construction schedule and short-interval schedule submittals.

C. Two-Week Look-Ahead Commissioning Schedule:

1. Two weeks prior to the beginning of tests, submit a detailed two-week look-ahead schedule. Thereafter, submit updated two-week look-ahead schedules weekly for the duration of commissioning process.
2. Two-week look-ahead schedules shall identify the date, time, beginning location, Contractor personnel required, and anticipated duration for each startup or test activity.
3. Use two-week look-ahead schedules to notify and coordinate participation of Owner's witnesses.

D. Owner's Witness Coordination:

1. Coordinate Owner's witness participation via Architect.
2. Notify Architect of commissioning schedule changes at least two work days in advance for activities requiring the participation of Owner's witness.

3.9 COMMISSIONING REPORTS

A. Test Reports:

1. Pre-startup reports include observations of the conditions of installation, organized into the following sections:
  - a. Equipment Model Verification: Compare contract requirements, approved submittals, and provided equipment. Note inconsistencies.
  - b. Preinstallation Physical Condition Checks: Observe physical condition of equipment prior to installation. Note conditions including, but not limited to, physical damage, corrosion, water damage, or other contamination or dirt.
  - c. Preinstallation Component Verification Checks: Verify components supplied with the equipment, preinstalled or field installed, are correctly installed and functional. Verify external components required for proper operation of equipment correctly installed and functional. Note missing, improperly configured, improperly installed, or nonfunctional components.
  - d. Summary of Installation Compliance Issues and Corrective Actions: Identify installation compliance issues and the corrective actions for each. Verify that issues noted have been corrected.
  - e. Evaluation of System Readiness for Startup: For each item of equipment for each system for which startup is anticipated, document in summary form acceptable to Owner completion of equipment model verification, preinstallation physical condition checks, preinstallation component verification checks, and completion of corrective actions for installation compliance issues.
2. Test data reports include the following:
  - a. "As-tested" system configuration. Complete record of conditions under which the test was performed, including, but not limited to, the status of equipment, systems, and assemblies; temporary adjustments and settings; and ambient conditions.

- b. Data and observations, including, but not limited to, data trend logs, recorded during the tests.
  - c. Signatures of individuals performing and witnessing tests.
  - d. Data trend logs accumulated overnight from the previous day of testing.
3. Commissioning Compliance Issue Reports: Report as commissioning compliance issues results of tests and test demonstrations that do not comply with acceptance criteria. Report only one issue per commissioning compliance issue report. Use sequentially numbered facsimiles of commissioning compliance issue report form included in this Section, or other form approved by Owner. Distribute commissioning compliance issue reports to parties responsible for taking corrective action. Identify the following:
- a. Commissioning compliance issue report number. Assign unique, sequential numbers to individual commissioning compliance issue reports when they are created, to be used for tracking.
  - b. Action distribution list.
  - c. Report date.
  - d. Test number and description.
  - e. Equipment identification and location.
  - f. Briefly describe observations about the performance associated with failure to achieve acceptable results. Identify the cause of failure if apparent.
  - g. Diagnostic procedure or plan to determine the cause (include in initial submittal)
  - h. Diagnosis of fundamental cause of issues as specified below (include in resubmittal).
  - i. Fundamental cause of unacceptable performance as determined by diagnostic tests and activities.
  - j. When issues have been resolved, update and resubmit the commissioning issue report forms by completing Part 2. Identify resolution taken and the dates and initials of the persons making the entries.
  - k. Schedule for retesting.
4. Weekly progress reports include information for tests conducted since the preceding report and the following:
- a. Completed data forms.
  - b. Equipment or system tested, including test number, system or equipment tag number and location, and notation about the apparent acceptability of results.
  - c. Activities scheduled but not conducted per schedule.
  - d. Commissioning compliance issue report log.
  - e. Schedule changes for remaining Commissioning-Process Work, if any.
5. Data trend logs shall be initiated and running prior to the time scheduled for the test demonstration.
- a. Trend log data format shall be multiple data series graphs. Where multiple data series are trend logged concurrently, present the data on a common horizontal time axis. Individual data series may be presented on a segmented vertical axis to avoid interference of one data series with another, and to accommodate different axis

- scale values. Graphs shall be sufficiently clear to interpret data within the accuracy required by the acceptance criteria.
- b. Attach to the data form printed trend log data collected during the test or test demonstration.
  - c. Record, print out, and attach to the data form operator activity during the time the trend log is running. During the time the trend log is running, operator intervention not directed by the test procedure invalidates the test results.
6. System Alarm Logs: Record and print out a log of alarms that occurred since the last log was printed. Evaluate alarms to determine if the previous day's work resulted in any conditions that are not considered "normal operation."
- a. Conditions that are not considered "normal operation" shall be reported on a commissioning issue report attached to the alarm log. Resolve as necessary. The intent of this requirement is to discover control system points or sequences left in manual or disabled conditions, equipment left disconnected, set points left with abnormal values, or similar conditions that may have resulted from failure to fully restore systems to normal, automatic control after test completion.

### 3.10 CERTIFICATE OF CONSTRUCTION-PHASE COMMISSIONING PROCESS COMPLETION

- A. When Contractor considers that construction-phase commissioning process, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and Commissioning Authority through Architect a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to complete commissioning process.
- B. On receipt of Contractor's list, Commissioning Authority will make an inspection to determine whether the construction-phase commissioning process or designated portion thereof is complete. If Commissioning Authority's inspection discloses items, whether included on Contractor's list, which is not sufficiently complete as defined in "Construction-Phase Commissioning Process Completion" Paragraph in the "Definitions" Article, Contractor shall, before issuance of the Certificate of Construction-Phase Commissioning Process Completion, complete or correct such items on notification by Commissioning Authority. In such case, Contractor shall then submit a request for another inspection by Commissioning Authority to determine construction-phase commissioning process completion.
- C. Contractor shall promptly correct deficient conditions and issues discovered during commissioning process. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense.
- D. When construction-phase commissioning process or designated portion is complete, Commissioning Authority will prepare a Certificate of Construction-Phase Commissioning Process Completion that shall establish the date of completion of construction-phase

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commissioning process. Certificate of Construction-Phase Commissioning Process Completion shall be submitted prior to requesting inspection for determining date of Final Acceptance.

END OF SECTION 019113

## SECTION 019119.43 - EXTERIOR ENCLOSURE COMMISSIONING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes building enclosure Cx process requirements for the above- and below-grade systems and assemblies:
  - 1. Horizontal and vertical waterproofing.
  - 2. Opaque walls.
  - 3. Roofs.
  - 4. Openings.
  - 5. Interfaces.
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general requirements for Cx processes including definitions, Cx team membership, Owner's responsibilities, Contractor's responsibilities, and CxA's responsibilities.

#### 1.3 DEFINITIONS

- A. Building Enclosure: Materials, components, systems, and assemblies intended to provide shelter and environmental separation between interior and exterior, or between two or more environmentally distinct interior spaces in a building or structure. The building enclosure includes, but is not limited to, exterior walls, above and below grade, and roof assemblies.
- B. Cx: Commissioning, as defined in Section 109113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- D. First-Installation Mockups: Initial installation of specific enclosure materials, components, systems, and assemblies that are part of Work.

- E. Integrated Exterior Mockups: Integrated mockups of the exterior enclosure erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
- F. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- G. Water Penetration: Visible evidence of uncontrolled water penetration on or adjacent to the test specimen in a location not intended to collect and drain water to the building exterior.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Construction Checklists: Draft Construction Checklists will be created by CxA for Contractor review.
- C. Cx Process Submittals:
  - 1. Shop Drawings: For mockups, including elevations, plans, sections, and full-size details. Show interface conditions, interconnections, and terminations.
  - 2. Testing Program: Developed specifically for Project.
  - 3. Test Reports: Prepared by a qualified testing agency for each test.
  - 4. Record Drawings: As-built drawings of mockups showing changes made during testing.
- D. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For building envelope systems and components to include in operation and maintenance manuals.

#### 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated.
- B. Build mockups to evaluate constructability and performance, and demonstrate the coordination of trades and sequencing of work necessary to ensure functional and integrated performance of materials, components, systems, assemblies, and interfaces.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 2. Notify Architect and CxA seven days in advance of the dates and times when mockups will be constructed and tested.



- C. Integrated Exterior Mockups: Build at Project site on site at locations indicated on Drawings.
- D. First Installation Mockups: Prepare each major exterior enclosure system for testing when first installed and before proceeding with construction of additional similar assemblies. If in compliance, Work may remain as part of the completed construction.
  - 1. Wall Mockups: Extend one full structural bay wide by one full story high plus additional height to connect to assemblies below and above. Include a typical wall to interior floor slab connections.
    - a. Minimum Size: 100 sq. ft.
  - 2. Roof Mockups: Include parapet or roof edge conditions, flashings, and typical pipe, dunnage, and similar penetrations.
    - a. Minimum Size: 100 sq. ft.
  - 3. Horizontal Below-Grade Waterproofing and Slab-on-Grade Mockups: Include edge conditions and typical penetrations.
    - a. Minimum Size: 100 sq. ft.
  - 4. Vertical Below-Grade Waterproofing Mockups: Include edge, termination, and penetrations.
- E. Mockups specified for quality assurance and control in the following sections may be combined with Cx mockups for testing purposes.
  - 1. Section 042000 "Unit Masonry."
  - 2. Section 072726 "Fluid-Applied Membrane Air Barriers."
  - 3. Section 074113.16 "Standing Seam Metal Roof Panels."
  - 4. Section 084413 "Glazed Aluminum Curtain Walls."

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed Construction Checklists for exterior enclosure Cx systems, subsystems, equipment, and components. Complete and submit Construction Checklists.

### 3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft Construction Checklists. CxA will create required draft Construction Checklists and provide them to Contractor.

- B. Return draft Construction Checklist review comments within 10 days of receipt.
- C. When review comments have been resolved, CxA will provide final Construction Checklists, marked "Approved for Use, (date)."
- D. Use only Construction Checklists, marked "Approved for Use, (date)."

### 3.3 GENERAL TESTING REQUIREMENTS

- A. If tests cannot be completed because of a deficiency outside the scope of the building enclosure systems, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
- B. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- C. Coordinate schedule with and perform Cx activities at the direction of the CxA.

### 3.4 INTEGRATED EXTERIOR MOCKUP TESTING

- A. Integrated Exterior Mockup Testing Program: Provide initial testing and verification of systems demonstrated in exterior enclosure mockups prior to construction of in place building systems according to the testing requirements below for BUILDING ENCLOSURE PERFORMANCE TESTING.

### 3.5 BUILDING ENCLOSURE PERFORMANCE TESTING

- A. Building Enclosure Testing: Perform testing before installation of interior finishes unless otherwise indicated.
- B. Air Barrier Leakage:
  - 1. Areas of fluid applied air barrier will be tested in general accordance with ASTM E1186.
    - a. Number of Tests: A total of 20 tests will be performed.
    - b. The Owner will randomly select the test areas.
  - 2. Timing of Tests:
    - a. First Tests: No later than 25 percent of completion of the air barrier system.
    - b. Additional Tests:
      - 1) At 80 percent completion.
    - c. The contractor is responsible for repairing the air barrier at the test locations.
  - 3. When testing results in failure, eliminate causes of the failure and retest until no failures occur.

- a. The costs of retesting shall be borne by the Contractor.
- C. Exterior Joint Sealant Adhesion:
- 1. Areas of exterior joint sealant will be tested in general accordance with ASTM C1521.
    - a. Number of Tests: A total of 10 tests will be performed.
    - b. The Owner will randomly select the test areas.
  - 2. Timing of Tests:
    - a. First Tests: No later than 25 percent of completion of the sealant system.
    - b. Additional Tests:
      - 1) At 80 percent completion.
    - c. The contractor is responsible for repairing the exterior sealants at the test locations.
  - 3. When testing results in failure, eliminate causes of the failure and retest until no failures occur.
    - a. The costs of retesting shall be borne by the Contractor.
- D. Pressure Chamber (Air Infiltration and Water Penetration) Testing (Storefront and Curtain Wall):
- 1. Air Infiltration: Areas of curtain wall and storefront will be tested for air leakage of 1.5 times the rate specified for laboratory testing, but not more than 0.5 cfm/sq. ft. of fixed wall area when tested in general accordance with ASTM E783 at a minimum static-air-pressure differential of 6.24 lbs/sq. ft.
    - a. Test Area: At least one bay wide by one bay tall, but no greater than 10 x10 feet.
    - b. Number of Tests: A total of 6 tests will be performed.
    - c. The Owner will randomly select the test areas.
  - 2. Water Penetration: Areas of curtain wall and storefront will be tested for water penetration at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the rate specified for laboratory testing, when tested in general accordance with ASTM E1105, but not less than 6.24 lbs/sq. ft.
    - a. Test Area: At least one bay wide by one bay tall, but no greater than 10 x10 feet.
    - b. Number of Tests: A total of 6 tests will be performed.
    - c. The Owner will randomly select the test areas.
  - 3. Timing of Tests:
    - a. First Tests: No later than 15 percent of completion of the curtain wall or storefront system.
    - b. Additional Tests:

- 1) .
      - 2) At 80 percent completion.
    - c. Testing is to be done before interior finishes are started.
  4. When testing results in leakage, eliminate causes of leaks and retest until no leaks occur.
    - a. The costs of retesting shall be borne by the Contractor.
- E. Nozzle (Water Spray) Testing (Storefront, Windows, and Curtain Wall):
1. Areas of curtain wall and storefront will be tested for water penetration in general accordance with AAMA 501.2 using a monarch nozzle.
    - a. Test Area: At least one bay wide by one bay tall, but no greater than 10 x10 feet.
    - b. Number of Tests: A total of 8 tests will be performed.
    - c. The Owner will randomly select the test areas.
  2. Timing of Tests:
    - a. First Tests: No later than 30 percent of completion of the curtain wall or storefront system.
    - b. Additional Tests:
      - 1) At 60 percent completion.
      - 2) At 90 percent completion.
    - c. Testing is to be done before interior finishes are started.
  3. When testing results in leakage, eliminate causes of leaks and retest until no leaks occur.
    - a. The costs of retesting shall be borne by the Contractor.
- F. Roof Uplift:
1. Areas of the roof will be tested for uplift resistance in general accordance with FM 1-52.
    - a. Test Area: Approximately 5 x 5 feet.
    - b. Number of Tests: A total of 4 tests will be performed. Two in the field of the roof,
    - c. one at the perimeter of the roof and one at the corner of the roof.
    - d. The Owner will randomly select the test areas.
  2. Timing of Tests:
    - a. Field Test: At 100 percent completion.
    - b. The contractor is responsible for repairing the roof membrane at the test locations.
  3. When testing results in failure, eliminate causes of the failure and retest until no failures occur.

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- a. The costs of retesting shall be borne by the Contractor.

END OF SECTION 019119.43



## SECTION 024100 - DEMOLITION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Demolition of designated site improvements including paving, curbing, site walls, buildings, and utility structures.
  - 2. Demolition of below-grade foundations and site improvements to depth to avoid conflict with new construction or site work.
  - 3. Removal of hollow items or items which could collapse.
  - 4. Salvage of designated items.
  - 5. Protection of designated site improvements, site work, adjacent construction and adjacent structures.
  - 6. Interruption, disconnection, capping, and removal of utilities.
  - 7. Pollution control during building demolition, including noise control.
  - 8. Removal and legal disposal of materials.
  - 9. Notification to OWNER and local jurisdiction of schedule of shut-off of utilities which serve occupied spaces.
- B. Hazardous Materials:
  - 1. Notifications regarding discovery.

#### 1.2 SUBMITTALS

- A. Section 013300 - Submittal Procedures specifies requirements for submittals.
- B. Schedule: Submit for approval selective demolition schedule, including schedule and methods for capping utilities to be abandoned and maintaining existing utility service.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements specifies requirements for submittals.
- B. Project Record Documents: Record actual locations of abandoned and capped utilities in accordance with Section 010400.00 – Construction Surveying.

#### 1.4 QUALITY ASSURANCE

- A. Codes and Regulations: Comply with governing codes and regulations. Use experienced workers.

## 1.5 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this Section.

## 1.6 SEQUENCING

- A. Immediate areas of work will not be occupied during selective demolition. Public, including children, may occupy adjacent areas.
- B. No responsibility for buildings and structures to be demolished will be assumed by OWNER.
- C. Ensure that products of this Section are supplied to affected trades in time to prevent interruption of construction progress.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements specifies requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging including application instructions.

## 1.8 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS – Not Used

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements specifies requirements for installation examination.
- B. If hazardous materials are encountered during construction, immediately stop work within area of hazardous materials; address any emergency situations; and notify OWNER, ENGINEER, and pertinent regulatory agencies upon discovery of hazardous materials.
- C. Do not resume work within area of hazardous materials until affected area has been rendered safe to resume work, special conditions have been addressed, and required permits have been acquired.



### 3.2 SELECTIVE DEMOLITION

- A. General:
  - 1. Use of explosives is not permitted.
  - 2. Obtain necessary demolition permits and inspections required by the local jurisdiction.
  - 3. Conduct demolition to minimize interference with adjacent structures and properties.
  - 4. Cease operations immediately when adjacent structures or improvements appear to be in danger.
  - 5. Conduct operations with minimum interference to public or private accesses.
  - 6. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon, or limit access to their property.
  - 7. Provide water or other method for dust control.
  - 8. Remove existing items as required for new construction.
- B. Demolition Operations: Do not damage building elements and improvements indicated to remain. Items of salvage value, not included on schedule of salvage items to be returned to OWNER, shall be removed from structure. Storage or sale of items at project Site is prohibited.
- C. Utilities:
  - 1. Disconnect and cap designated utilities to street connection.
  - 2. Identify utilities at termination of demolition.
  - 3. Record termination or capped location on Record Documents.
- D. Shoring and Bracing: Provide and maintain interior and exterior shoring and bracing.
- E. Occupied Spaces: Do not close or obstruct streets, walks, drives or other occupied or used spaces or facilities without written permission of OWNER and authorities having jurisdiction. Do not interrupt utilities serving occupied or used facilities without written permission of OWNER and local jurisdiction. If necessary, provide temporary utilities as directed by the local jurisdiction.
- F. Operations: Cease operations if public safety or remaining structures are endangered. Perform temporary corrective measures until operations can be continued properly.
- G. Security: Provide adequate protection against accidental trespassing. Secure project after work hours.
- H. Restoration: Restore finishes of patched areas.
- I. Excavate as required to expose and remove items.
- J. Saw cut and breakup concrete as necessary for removal. Where possible remove concrete to nearest joint. Do not leave jagged edges. Where indicated, remove concrete slabs-on-grade.

- K. Remove foundation walls and footings to minimum of two feet below finished grade within area of new construction.
- L. Where indicated, remove existing pipe culverts. If existing pipe culverts are in good condition, remove in manner to prevent damage. Stockpile pipe culverts in good condition along edge of roadway for OWNER to salvage.
- M. Where indicated, remove concrete headwalls, drainage boxes and other miscellaneous structures.
- N. Remove signs and mailboxes as required for new construction. Where indicated, re-install signs and mailboxes to designated locations.
- O. For traffic regulatory signs, install signs in temporary locations until signs can be installed in final locations.
- P. Where indicated, obliterate existing road. Follow below unless specified otherwise Drawings.
  - 1. Remove existing pavement.
  - 2. Scarify road to depth of one foot.
  - 3. Fill depressions and form rounded slopes to blend with surrounding contours.
- Q. Remove and relocate fence and gate as indicated on Drawings.
- R. Remove materials to be re-installed or retained in manner to prevent damage; store and protect during construction.
- S. Backfill areas excavated resulting from demolition. Compact backfill to density of surrounding ground or as indicated for new construction.
- T. Rough grade and compact areas affected by demolition to maintain Site grades and contours.
- U. Continuously clean up and remove demolished materials from Site. Do not allow materials to accumulate on-Site.
- V. Do not burn or bury materials on-Site. Leave Site in clean condition. Dispose of demolition materials off-Site.
- W. Re-install indicated items. Re-install to equal or better condition as existed prior to construction.

### 3.3 PROTECTION

- A. Protect existing built environment including utilities unless indicated to be removed.
- B. Protect adjoining areas surrounding items to be removed.

### 3.4 PROTECTION SCHEDULE

- A. Items for Protection During Demolition and Construction:
  - 1. Existing trees as indicated on Drawings.
  - 2. Existing utilities to remain in serviced.
  - 3. Existing stairways and walkways as indicated on Drawings.
  - 4. Existing buildings and structures.
  - 5. Existing streams or ditches as indicated on Drawings.
  - 6. Existing property and adjoining property fencing.
  - 7. Adjoining properties except as indicated on Drawings. Verify property access and/or easements are in place before commencing work on adjoining properties.
- B. CONTRACTOR shall coordinate with OWNER and ENGINEER regarding Items to be Salvaged for Reinstallation in accordance with plan drawings.
- C. CONTRACTOR shall coordinate with OWNER and ENGINEER regarding Utilities Requiring Interruption, Capping, or Removal.

### 3.5 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements specifies requirements for inspecting and testing.
- B. Section 017000 - Execution and Closeout Requirements specifies requirements for testing, adjusting, and balancing.

### 3.6 CLEANING

- A. Section 017000 - Execution and Closeout Requirements specifies requirements for cleaning.

### 3.7 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements specifies requirements for protecting finished Work.

### 3.8 MAINTENANCE

- A. Section 017000 - Execution and Closeout Requirements specifies requirements for maintenance service.

END OF SECTION 024100



## SECTION 033000 - CAST-IN-PLACE CONCRETE

### 1.1 SUMMARY

#### A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

#### B. Related Requirements:

1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Section 035300 "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
4. Section 321313 "Concrete Paving" for concrete pavement and walks.
5. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

### 1.2 DEFINITIONS

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

- #### B. Water/Cement Ratio (w/cm):
- The ratio by weight of water to cementitious materials.

### 1.3 PREINSTALLATION MEETINGS

- #### A. Preinstallation Conference:
- Conduct conference at the Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
  - a. Contractor's superintendent.
  - b. Independent testing agency responsible for concrete design mixtures.
  - c. Ready-mix concrete manufacturer.
  - d. Concrete Subcontractor.
2. Review the following:
  - a. Special inspection and testing and inspecting agency procedures for field quality control.

- b. Construction joints, control joints, isolation joints, and joint-filler strips.
- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Methods for achieving specified floor and slab flatness and levelness.
- k. Floor and slab flatness and levelness measurements.
- l. Concrete repair procedures.
- m. Concrete protection.
- n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- o. Protection of field cured field test cylinders.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Slag cement.
- 4. Blended hydraulic cement.
- 5. Silica fume.
- 6. Performance-based hydraulic cement
- 7. Aggregates.
- 8. Admixtures:
- 9. Vapor retarders.
- 10. Floor and slab treatments.
- 11. Liquid floor treatments.
- 12. Curing materials.
- 13. Joint Fillers
- 14. Repair materials

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

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.
- 5. Calculated equilibrium unit weight, for lightweight concrete.
- 6. Slump limit.
- 7. Air content.
- 8. Nominal maximum aggregate size.
- 9. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
- 10. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.

11. Intended placement method.
12. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - a. Location of construction joints is subject to approval of the Architect.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

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

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

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.
6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

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

1. Portland cement.
2. Fly ash.

3. Slag cement.
  4. Blended hydraulic cement.
  5. Silica fume.
  6. Performance-based hydraulic cement.
  7. Aggregates.
  8. Admixtures:
    - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
  2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.
- I. Environmental Product Declaration (EPD):
1. Submit a product-specific EPD for 90% by volume for all concrete mixes used in the project in the "Concrete Mix Specification Table" within the Concrete section of the structural general notes.
  2. Impact Categories:
    - a. Global Warming Potential (GWP): All GWP information submitted shall be in the form of  $\text{kgCO}_2\text{eq/kg}$ .
    - b. Ozone Depletion Potential (ODP): All ODP information submitted shall be in the form of  $\text{kgCFC-11/kg}$ .
    - c. Acidification Potential (AP): All AP information submitted shall be in the form of  $\text{kgSO}_2/\text{kg}$ .
    - d. Eutrophication Potential (EP): All EP information submitted shall be in the form of  $\text{kg N/kg}$ .
    - e. Smog Formation Potential (SFP): All SFP information submitted shall be in the form of  $\text{kgO}_3/\text{kg}$ .
    - f. Non-Renewable Energy Consumption (NREC): All NREC information submitted shall be in the form of MJ.
  3. Plant-specific GWP information will be one of the decision criteria when awarding this scope. However, information for each impact category noted above will be reviewed. The impact category information will be evaluated against both industry average impact



category datasets, as defined by National Ready Mix Concrete Association (NRMCA) regional mix EPD datasets, as well as the impact category information reported within mill-specific EPDs from competing bidders. If mill-specific impact category information is not provided, industry average EPDs will be used.

- J. Bill of Materials: Material supplier(s) shall provide a report to the General Contractor, at the completion of 100% Construction Documents, or as soon thereafter when the material sources are known, and at the completion of the primary structural frame, summarizing all concrete quantities and the location where each material was obtained. Each unique mix design used on the project shall be itemized.
  - 1. In addition to the requirements above, report the following in cubic yards for concrete and itemize as required for each unique mix design:
    - a. Total Concrete Volume

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician with experience installing and finishing concrete, incorporating permeability-reducing admixtures.
  - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
  - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
  - 1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

## 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
  - 1. Include the following information in each test report:
    - a. Admixture dosage rates.
    - b. Slump.
    - c. Air content.
    - d. Seven-day compressive strength.
    - e. 28-day compressive strength.
    - f. Permeability.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and ACI 301.

## 1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
  - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
  - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  - 3. Do not use frozen materials or materials containing ice or snow.
  - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
  - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
  - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
  - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## 1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

### 2.2 CONCRETE MATERIALS

#### A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
3. Obtain aggregate from single source.
4. Obtain each type of admixture from single source from single manufacturer.

#### B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I or Type III.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

#### C. Normal-Weight Aggregates: ASTM C33/C33M, Class 4M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (nominal) for footings below grade, 1 inch (nominal) for slabs and walls.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

#### D. Air-Entraining Admixture: ASTM C260/C260M.

#### E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. 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. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

7. Permeability-Reducing Admixture: ASTM C494/C494M, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
  - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRD C48 at a hydraulic pressure of 200 psi for 14 days.

- F. Water and Water Used to Make Ice: ASTM C94/C94M, potable or complying with ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4

## 2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class C: ASTM E1745, Class C not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

## 2.4 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  1. Color:
    - a. Ambient Temperature Below 50 deg F: Black.
    - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
    - c. Ambient Temperature Above 85 deg F: White.
- C. Water: Potable or complying with ASTM C1602/C1602M.
- D. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

## 2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

- D. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:
1. Types I and II, nonload bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

## 2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
1. Fly Ash or Other Pozzolans: 20 percent by mass.

2. Slag Cement: 15 percent by mass.
3. Flyash shall not be used in combination with slag cement.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in concrete with a w/cm below 0.50.
4. Use permeability-reducing admixture in concrete mixtures where indicated.

D. Calcium Chloride shall not be permitted nor shall any admixture containing calcium chloride.

## 2.8 CONCRETE MIXTURES

A. Normal-weight concrete used for footings and piers below grade:

1. Exposure Class: ACI 318 F0
2. Minimum Compressive Strength at 28 Days: 3000psi.
3. Maximum w/cm: 0.60
4. Minimum Cementitious Materials Content: 470 lb/cu. yd.
5. Slump Limit: 5 inches, plus or minus 1 inch
6. Air Content: 0% to 3% Entrapped

B. Normal-weight concrete used for interior slabs-on-ground and interior elevated slabs:

1. Exposure Class: ACI 318 F0
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.48
4. Slump Limit: 3 to 5 inches
5. Air Content: 0% to 3% Entrapped

C. Normal-weight concrete used for exterior slabs-on-ground and concrete walls exposed to weather:

1. Exposure Class: ACI 318 F2
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Minimum Cementitious Materials Content: 564 lb/cu. yd.
5. Slump Limit: 5 inches, plus or minus 1 inch
6. Air Content: 6% +/- 1.5%

## 2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94 and furnish batch ticket information.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

#### 3.3 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

#### 3.4 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.

3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

- a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

### 3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
  1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
  2. Place joints perpendicular to main reinforcement.
    - a. Continue reinforcement across construction joints unless otherwise indicated.
    - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
  3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  5. Space vertical joints in walls at 60ft maximum unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
  6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated on plans. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
  1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.



1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

### 3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
  2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.

- d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  1. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  3. Maintain reinforcement in position on chairs during concrete placement.
  4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  5. Level concrete, cut high areas, and fill low areas.
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  8. Do not further disturb slab surfaces before starting finishing operations.

### 3.7 FINISHING FORMED SURFACES

#### A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
  - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
  - b. Remove projections larger than 1 inch.
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 Class D.
  - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/4 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view, receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

#### B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:
  - a. Perform no later than one day after form removal.

- b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
- c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
- d. Maintain required patterns or variances as shown on Drawings or to match design reference sample per architect.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### 3.8 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

- a. Slabs on Ground:
  - 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- b. Suspended Slabs:
  - 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated on Drawings where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
  - 1. Coordinate required final finish with Architect before application.
  - 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
  - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
  - 2. Coordinate required final finish with Architect before application.
- F. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish to concrete stair treads, platforms, ramps as indicated on Drawings
  - 1. Apply in accordance with manufacturer's written instructions and as follows:
    - a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications.
    - b. Tamp aggregate flush with surface, but do not force below surface.
    - c. After broadcasting and tamping, apply float finish.
    - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

### 3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
  - 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
  - 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
  - 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.
  - 1. Cast-in inserts and accessories, as shown on Drawings.
  - 2. Screed, tamp, and trowel finish concrete surfaces.

### 3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
  - 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
  - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
  - 3. Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating concrete, but before float finishing.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
  - 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
  - 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
  - 3. If forms remain during curing period, moist cure after loosening forms.
  - 4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
    - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
      - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
      - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
  - 1. Begin curing immediately after finishing concrete.

2. Interior Concrete Floors:

- a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.
  - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.

- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
  - a) Water.
  - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
  - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
  - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
  - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
  - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
  - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
  - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
  - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
  - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
  - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing and Sealing Compound:
  - 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.

- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

### 3.11 TOLERANCES

- A. Conform to ACI 117.

### 3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least one to six month(s).
  2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

### 3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
  1. Repair and patch defective areas when approved by Architect.
  2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
  1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
    - a. Limit cut depth to 3/4 inch.
    - b. Make edges of cuts perpendicular to concrete surface.
    - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
    - d. Fill and compact with patching mortar before bonding agent has dried.



- e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
- 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
  - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
  - b. Compact mortar in place and strike off slightly higher than surrounding surface.
- 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

- 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
  - a. Correct low and high areas.
  - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
- 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
- 3. After concrete has cured at least 14 days, correct high areas by grinding.
- 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
  - a. Finish repaired areas to blend into adjacent concrete.
- 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
  - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  - b. Feather edges to match adjacent floor elevations.
- 6. Correct other low areas scheduled to remain exposed with repair topping.
  - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
  - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
- 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

- a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
  - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
  - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
  - d. Place, compact, and finish to blend with adjacent finished concrete.
  - e. Cure in same manner as adjacent concrete.
8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
  - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
  - b. Dampen cleaned concrete surfaces and apply bonding agent.
  - c. Place patching mortar before bonding agent has dried.
  - d. Compact patching mortar and finish to match adjacent concrete.
  - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
  2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.

- 7) Location in Work of concrete represented by samples.
  - 8) Date and time sample was obtained.
  - 9) Truck and batch ticket numbers.
  - 10) Design compressive strength at 28 days.
  - 11) Concrete mixture designation, proportions, and materials.
  - 12) Field test results.
  - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
  - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Inspections:
1. Headed bolts and studs.
  2. Verification of use of required design mixture.
  3. Concrete placement, including conveying and depositing.
  4. Curing procedures and maintenance of curing temperature.
  5. Verification of concrete strength before removal of shores and forms from beams and slabs.
  6. Batch Plant Inspections: On a random basis, as determined by Architect.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C143/C143M:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete;
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  4. Concrete Temperature: ASTM C1064/C1064M:

- a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M:
  - a. Cast and laboratory cure two sets of two 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M.
  - a. Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.
  - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
9. Additional Tests:
  - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
  - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
    - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.6.6.3.
10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Architect.

### 3.15 PROTECTION

- A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000



## SECTION 042000 - UNIT MASONRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exposed Decorative Concrete masonry units
  - 2. Concrete masonry units.
- B. Related Sections:
  - 1. Section 07 21 00 - "Thermal Insulation" for insulation to be installed in cavity walls.

#### 1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
- C. Samples for Verification: For each type and color of exposed masonry unit and colored mortar.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each type and size of product. For masonry units, include material test reports substantiating compliance with requirements.
- B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
  2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- C. Environmental Product Declaration (EPD) Submit an EPD for each block type and grout mix design specified in the Masonry section of the .
1. Impact Categories:
    - a. Global Warming Potential (GWP): All GWP information submitted shall be in the form of kgCO<sub>2</sub>eq/kg.

## 1.6 QUALITY ASSURANCE

- A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.
1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 60 inches long by 48 inches high by full wall thickness including backup materials.

## 1.7 FIELD CONDITIONS

- A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain exposed masonry units from single source.
- B. For exposed masonry units, obtain each color and grade from single source with resources to provide materials of consistent quality in appearance and physical properties.



## 2.2 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops net-area compressive strength at 28 days as shown on structural drawings
  - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit strength method) in accordance with TMS 602/ACI 530.1/ASCE 6
  - 2. Determine net-area compressive strength of masonry by testing masonry prisms in accordance with ASTM C1314.

## 2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/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, 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.

## 2.4 CONCRETE MASONRY UNITS

- A. Decorative CMUs: ASTM C90, **normal weight**
  - 1. Basis-of-Design Product: **Oldcastle Adams 4205** or one of the following:
    - a. Johnson Concrete
    - b. E Dillon & co, USA
  - 2. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph above.
  - 3. Pattern and Texture: Standard pattern, **ground-face finish**
  - 4. Colors: As selected by Architect from manufacturer's full range.
  - 5. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.
- B. Concrete Face Brick: ASTM C1634, normal weight.
  - 1. Basis-of-Design Product: **Jandris Block** or one of the following:
    - a. Old Castle

- b. Johnson Concrete
  - c. E Dillon & co, USA
- 2. Size (Actual Dimensions): 1 5/8 inches wide by 7 5/8" high by 15-5/8 inches long.
  - 3. Texture: Ground-face finish.
  - 4. Colors: As selected by Architect from manufacturer's full range.
  - 5. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.
- C. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
- 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, bonding, and other special conditions.
- D. CMUs: ASTM C 90.
- 1. Density Classification: Lightweight.

## 2.5 CONCRETE LINTELS

- A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

## 2.6 MORTAR AND GROUT MATERIALS

- A. General: Mortar Selection and color for brick masonry to be approved by owner. MORTAR SHALL MATCH THE BRICK MASONRY MORTAR. SECTION 042113.

## 2.7 REINFORCEMENT

- A. Uncoated-Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60
- B. Masonry-Joint Reinforcement, General: ASTM A 951/A 951M.
  - 1. Reinforcing: carbon steel with hot-dip galvanizing after fabrication.
  - 2. Wire Size for Side Rods: 0.187-inch diameter.
  - 3. Wire Size for Cross Rods: 0.148-inch diameter.
  - 4. Wire Size for Veneer Ties: 0.187-inch diameter.
  - 5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
  - 6. Provide in lengths of not less than 10 feet , with prefabricated corner and tee units.

## 2.8 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. All Brick Ties: stainless steel
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, stainless steel.
  - 2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, stainless steel.
- D. Partition Top Anchors: 0.105-inch- thick metal plate with a 3/8-inch- diameter metal rod 6 inches 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 stainless steel.
- E. Adjustable Masonry-Veneer Anchors:
  - 1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch .
  - 2. Masonry-Veneer Anchors; Single-Barrel Screw with Double-Pintle Wingnut: Self-drilling, single-barrel screw with wingnut head designed to receive double-pintle wire tie. Screw has a smooth barrel the same thickness as insulation with factory-installed gasketed washer to seal at face of insulation and sheathing.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Heckmann Building Products Inc.; Pos-I-Tie Thermal Clip with Thermal Grip Insulation Fasteners. Basis of Design.
      - 2) Hohmann & Barnard, Inc; 2-Seal Thermal Wing Nut Anchor.
      - 3) Wire-Bond; SureTie.
    - b. Anchor Section: Corrosion-resistant, self-drilling, eye-screw with thermally broken clip designed to receive wire tie. Provide anchor appropriate to substrate: concrete, masonry, structural steel or metal studs. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head that covers hole in sheathing. Provide manufacturer's oversized Thermal-Grip washers designed to grip and retain rigid insulation board.
    - c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch- (4.76-mm-) diameter, stainless-steel wire

## 2.9 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with Section 076200 "Sheet Metal Flashing and Trim" and as follows.
  - 1. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees.
- B. Flexible Flashing: Use the following unless otherwise indicated:
  - 1. Laminated Stainless Steel Flashing: Stainless Steel core with polymer fabric laminated to the bottom stainless steel face with non-asphaltic adhesive.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Hohmann & Barnard, Inc; Mighty-Flash.
      - 2) York Manufacturing, Inc; Multi-Flash SS.
      - 3) Illinois Products, Inc.; IPCO Stainless Steel Fabric Flashing.
      - 4) Prosoco, Inc.; R-Guard SS ThruWall
      - 5) STS Coatings, Inc.; Wall Guardian Stainless Steel TWF
    - b. Provide 26 ga. preformed inside and outside stainless steel corners, stainless steel end dams and stainless steel termination bars by the same manufacturer as the flashing.
    - c. Provide manufacturer's warranty for flashing material and accessories for life of the wall to begin at the date of Project Acceptance.
- C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.10 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).
- D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:
- E. Wicking Material: Absorbent rope, made from cotton, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity. Use only for weeps .

- F. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Advanced Building Products Inc.; Mortar Break II.
  - b. Heckmann Building Products, Inc.; Weep-Thru Mortar Deflector.
  - c. Hohmann & Barnard, Inc; Mortar Trap.
  - d. Mortar Net USA, Ltd; Mortar Net.
  - e. Wire-Bond; Cavity Net II.
2. Configuration: Provide one of the following:
  - a. Strips, full depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.

## 2.11 MASONRY CLEANERS

- A. Non-Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cleanse It All Global.
    - b. Diedrich Technologies, Inc.; a division of Sandell Construction Solutions.
    - c. PROSOCO, Inc.

## 2.12 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
  2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
  3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.
1. For reinforced masonry, use Type S.

2. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
- C. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
  2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi .
  3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

#### 3.2 MORTAR BEDDING AND JOINTING

- A. Lay CMUs as follows:
  1. Bed face shells in mortar and make head joints of depth equal to bed joints.
  2. Bed webs in mortar in all courses of piers, columns, and pilasters.
  3. Bed webs in mortar in grouted masonry, including starting course on footings.
  4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated. For all brick, tool joints slightly concave\_

- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

### 3.3 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
  - 1. Space reinforcement not more than 16 inches o.c.
  - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.

### 3.4 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
  - 1. Provide an open space not less than 2 inches wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### 3.5 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 that of other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
  - 2. Limit height of vertical grout pours to not more than 60 inches.

### 3.6 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.
  - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
  - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
  - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

### 3.7 REPAIRING, POINTING, AND CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
  - 3. Protect adjacent surfaces from contact with cleaner.



4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

### 3.8 MASONRY WASTE DISPOSAL

- A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
  1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. 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 051200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Structural steel.
  - 2. Shear stud connectors.
  - 3. Shrinkage-resistant grout.
- B. Related Requirements:
  - 1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
  - 2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
  - 3. Section 099113 Exterior Painting for painting requirements.

#### 1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
  - 1. Shapes included in ASTM A6/A6M with flanges thicker than 1-1/2 inches.
  - 2. Welded built-up members with plates thicker than 2 inches.
  - 3. Column base plates thicker than 2 inches.
- D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

#### 1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at the Project site.

#### 1.6 ACTION SUBMITTALS

- A. Product Data:
  - 1. High-strength, bolt-nut-washer assemblies.
  - 2. Structural-steel materials.
  - 3. Shear stud connectors.
  - 4. Anchor rods.
  - 5. Threaded rods.
  - 6. Shop primer.
  - 7. Galvanized-steel primer.
  - 8. Etching cleaner.
  - 9. Galvanized repair paint.
  - 10. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of structural-steel components.
  - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
  - 2. Include embedment Drawings.
  - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
  - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
  - 5. Identify members and connections of the seismic-load-resisting system.
  - 6. Indicate locations and dimensions of protected zones.
  - 7. Identify demand-critical welds.
  - 8. Identify members not to be shop primed.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:
  - 1. Power source (constant current or constant voltage).
  - 2. Electrode manufacturer and trade name, for demand-critical welds.

- D. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation. In addition, the professional engineer responsible for connection design shall review the shop drawings prior to submittal to verify that the connections detailed comply with the calculations provided as well as the design requirements. A review letter, signed and sealed by the professional engineer responsible for connection design, shall be provided with the shop drawings and calculations submittal stating that this review and verification has been completed.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, fabricator, Shop-Painting Applicator, testing agency.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural-steel materials, including chemical and physical properties.
- E. Product Test Reports: For the following:
  - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
  - 2. Direct-tension indicators.
  - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
  - 4. Shear stud connectors.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control reports.

#### 1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
- B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicators: Qualified in accordance with AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  1. ANSI/AISC 303.
  2. ANSI/AISC 341.
  3. ANSI/AISC 360.
  4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
  1. Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
    - a. Use Load and Resistance Factor Design; data are given at factored-load level.
- C. Moment Connections: Type FR, fully restrained.
- D. Construction: Shear wall system.

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992/A992M.

- B. Channels, Angles: ASTM A36/A36M.
- C. Plate and Bar: ASTM A36/A36M.
- D. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588/A588M, 50 ksi.
- E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
- F. Corrosion-Resisting (Weathering), Cold-Formed Hollow Structural Sections: ASTM A847/A847M structural tubing.
- G. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- H. Steel Forgings: ASTM A668/A668M.
- I. Welding Electrodes: Comply with AWS requirements.

## 2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.
- B. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

## 2.4 RODS

- A. Headed Anchor Rods: ASTM F1554, Grade 36, straight.
  - 1. Nuts: ASTM A563 heavy-hex carbon steel.
  - 2. Plate Washers: ASTM A36/A36M carbon steel.
  - 3. Washers: ASTM F436, Type 1, hardened carbon steel.
  - 4. Finish: Plain.
- B. Threaded Rods: ASTM A36/A36M.
  - 1. Nuts: ASTM A63 heavy-hex carbon steel.
  - 2. Washers: ASTM F436, Type 1, hardened carbon steel.
  - 3. Finish: Plain.

## 2.5 PRIMER

- A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings." Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
2. SSPC-Paint 23, latex primer.
3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#26.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 ASTM A780/A780M.

2.6 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
  1. Camber structural-steel members where indicated.
  2. Fabricate beams with rolling camber up.
  3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
  1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- F. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide



uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

- G. Welded-Steel Door Frames: Build up welded-steel door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated on Drawings.
- H. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
  - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.8 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

## 2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
  - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
  - 2. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

## 2.10 SHOP PRIMING

- A. Shop prime steel surfaces, except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
  - 3. Surfaces of high-strength bolted, slip-critical connections.
  - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
  - 5. Galvanized surfaces.
  - 6. Corrosion-resisting (weathering) steel surfaces.

7. Surfaces enclosed in interior construction.
- B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
  1. SSPC-SP 2.
- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner.
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
  1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
  2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.11 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
  1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
  2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E165/E165M.
    - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    - c. Ultrasonic Inspection: ASTM E164.
    - d. Radiographic Inspection: ASTM E94/E94M.
  4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
    - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
    - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
  5. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
  - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.
  - 1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Weld plate washers to top of baseplate.
  - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  - 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
1. Joint Type: Snug tightened unless otherwise noted
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
  3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

### 3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
  2. Cleaning and touchup painting are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections if specified on the documents.
  - 1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
    - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
      - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
      - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      - 3) Ultrasonic Inspection: ASTM E164.
      - 4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200



## SECTION 053100 - STEEL DECKING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Composite Floor Deck.

- B. Related Requirements:

- 1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
  - 2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
  - 3. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
  - 4. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:

- 1. Composite Floor Deck.

- B. Shop Drawings:

- 1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

- B. Product Certificates: For each type of steel deck.

- C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

D. Research Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

## 1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. 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."

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

### 2.2 COMPOSITE FLOOR DECK

A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:



1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 40, G60 coating.
2. Profile Depth: As indicated.
3. Design Uncoated-Steel Thickness: As indicated.
4. Span Condition: Triple span or more.

## 2.3 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated, and recommended by SDI Publication No. 31 for overhang and slab depth.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Galvanizing Repair Paint: ASTM A780/A780M
- K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
  - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

### 3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
  - 1. Weld Diameter: 5/8 inch nominal.
  - 2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
  - 3. Weld Spacing: Space and locate welds as indicated.
  - 4. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:
  - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
  - 2. Mechanically clinch or button punch.
  - 3. Fasten with a minimum of 1-1/2-inch-long welds.

- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches , with end joints as follows:
  - 1. End Joints Lapped or butted at Contractor's option.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

### 3.4 REPAIR

- 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:
  - 1. Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
  - 2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
  - 3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 4. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections if required on documents.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

END OF SECTION 053100



## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for operable partitions.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel framing and supports for mechanical and electrical equipment.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Elevator machine beams, hoist beams, and divider beams.
7. Steel shapes for supporting elevator door sills.
8. Shelf angles.
9. Metal ladders.
10. Steel Stairs.
11. Handrails.
12. Metal floor plate and supports.
13. Elevator pit sump covers.
14. Metal bollards.
15. Abrasive metal nosings.
16. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 051200 "Structural Steel Framing."

### 1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Nonslip aggregates and nonslip-aggregate surface finishes.
  - 2. Metal nosings and treads.
  - 3. Paint products.
  - 4. Grout.
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
  - 1. Steel framing and supports for ceiling-hung toilet compartments.
  - 2. Steel framing and supports for operable partitions.
  - 3. Steel framing and supports for overhead doors and grilles.
  - 4. Steel framing and supports for countertops.
  - 5. Steel framing and supports for mechanical and electrical equipment.
  - 6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 7. Elevator machine beams, hoist beams, and divider beams.
  - 8. Steel shapes for supporting elevator door sills.
  - 9. Shelf angles.
  - 10. Metal ladders.
  - 11. Steel Stairs
  - 12. Handrails
  - 13. Metal floor plate and supports.
  - 14. Elevator pit sump covers.
  - 15. Metal bollards.
  - 16. Abrasive metal nosings.
  - 17. Loose steel lintels.
- C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Welding certificates.

- C. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- E. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- F. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches.

- 2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, structural steel, Grade 33; 0.0966-inch minimum thickness; unfinished coated with rust-inhibitive, baked-on, acrylic enamel hot-dip galvanized after fabrication.
- G. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
- H. Aluminum Alloy Products
- I. Conform to ASTM B 209 for sheet plate, ASTM B221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings, as applicable. Provide aluminum extrusions at least 1/8-inch thick and aluminum plate or sheet at least 0.050 inch thick.

## 2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.
- D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.
- E. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.4 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 Interior Painting."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- C. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.



- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

## 2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
  - 1. Fabricate units from slotted channel framing where indicated.
  - 2. Furnish inserts for units installed after concrete is placed.
- C. Fabricate supports for operable partitions from continuous steel beams of sizes recommended by partition manufacturer with attached bearing plates, anchors, and braces as recommended by partition manufacturer. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.
- D. Galvanize miscellaneous framing and supports where indicated.
- E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## 2.7 FLOOR GRATINGS AND WALKWAYS

- A. Design aluminum grating in accordance with NAAMM BG for bar type grating or manufacturer's charts for plank grating. Grates, platforms, and frames shall be of aluminum or FRP construction. Aluminum grating shall be banded, and all items, shall be of sizes shown on the plans or sized to carry a live load of 150 pounds per square foot and a concentrated load of 200 pounds per square foot. Frames shall be fabricated for setting in concrete and shall be set even with the surrounding finished concrete surface or fabricated to the platform or stair requirements shown on the plans and sizes to support 150 pounds per square foot and concentrated load of 200 pounds per square foot. Fiber glass grating shall be manufactured from isophthalmic, fire retardant resin and may be molded or pultruded. Fiberglass frames may be shipped in 20 foot stock lengths and fabricated onsite.
  - 1. Design floor gratings to support a live load of 150 pounds per square foot for the spans indicated, with maximum deflection of  $L/240$ .
  - 2. NAAMM BG, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and match grating finish.
  - 3. Anchor gratings to structural members with bolts, toggle bolts, or expansion shields and bolts.
  - 4. Floor Grating and Walkway treads shall have abrasive non-slip nosing as approved.

## 2.8 HANDRAILS

- A. Design handrails to resist a concentrated load of 200 pounds in any direction at any point of the top of the rail or 20 pounds per square foot applied horizontally to top of rail, whichever is more severe. NAAMM PR, provide the same size rail and post. Provide pipe collars of the same material and finish as the handrail and posts. Provide series 300 stainless steel pipe collars.
- B. Aluminum Handrails
  - 1. Consists of 1½-inch nominal schedule 40 pipe ASTM B 429. Railings shall be mill finish aluminum. All fasteners shall be Series 300 stainless steel.
    - a. Fabrication
      - 1) Provide jointing by one of the following methods:
        - a) Flush-type rail fittings welded and ground smooth with splice locks secured with 3/8-inch recessed head set screw.
        - b) Mitered and welded joints made by fitting post to top rail, intermediate rail to post, and corners, shall be groove welded and ground smooth. Splices, where allowed by the ENGINEER, shall be butted and reinforced by a tight-fitting dowel or sleeve not less than 6 inches in length. Tack weld or epoxy cement dowel or sleeve to one side of the splice.
        - c) Assemble railings using slip-on aluminum-magnesium alloy fittings for joints. Fasten fittings to pipe or tube with 1/4 or 3/8-inch stainless steel recessed head setscrews. Provide assembled railings with fittings only at vertical supports or at rail terminations attached to walls. Provide expansion joints at the midpoint of panels. Provide a setscrew in only one side of the slip-on sleeve. Provide fittings to conform to ASTM B 26/B 26M.
      - b. Provide toe-boards and brackets where indicated, using flange castings as appropriate.

## 2.9 STEEL STAIRS

- A. Provide aluminum stairs complete with stringers, aluminum-plate treads and risers, landings, columns, handrails, and necessary bolts and other fastenings. Stairs and accessories to be aluminum.
- B. Design Loads
  - 1. Design stairs to sustain a live load of not less than 200 pounds per square foot, or a concentrated load of 500 applied where it is most critical. Conform to AISC S335 or AISC S342L with the design and fabrication of steel stairs, other than a commercial product.
- C. Materials

1. Provide steel stairs of welded construction except, bolts may be used where welding is not practicable. Screw or screw-type connections are not permitted.
  - a. Structural Steel
    - 1) ASTM A 36/A 36M
  - b. Gratings for Treads and Landings.
    - 1) NAAMM BG or plank grating
    - a) ASTM A 653A 653M, G90 for steel; ASTM B 209 for aluminum
    - b) Provide gratings with nonslip nosing
  - c. Support steel floor plate and steel grating on angle cleats welded to stringers or treads with integral cleats, welded or bolted to the stringer. Close exposed ends. Exterior stairs shall have all exposed joints formed to exclude water.
  - d. Before fabrication, obtain necessary field measurements and verify drawing dimensions.
  - e. Clean metal surfaces free from mill scale, flake rust, and rut pitting prior to shop finishing. Weld permanent connections. Finish welds flush and smooth on surfaces that will be exposed after installation.

## 2.10 SHELF ANGLES

- A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
  1. Provide mitered and welded units at corners.
  2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
- B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
- C. Galvanize shelf angles located in exterior walls.

## 2.11 METAL LADDERS

- A. General:
  1. Comply with ANSI A14.3, except for elevator pit ladders.
  2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
- B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 1-inch-diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
7. Galvanize exterior ladders, including brackets.
8. Prime exterior ladders, including brackets and fasteners, with zinc-rich primer.

## 2.12 METAL FLOOR PLATE

- A. Fabricate from rolled-stainless-steel floor plate of thickness indicated below:
  1. Thickness: As indicated.
- B. Include steel angle stiffeners, and fixed and removable sections as indicated.

## 2.13 ELEVATOR PIT SUMP COVERS

- A. Fabricate from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 1 inch in least dimension.
- B. Provide steel angle supports as indicated.

## 2.14 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe.
  1. Cap bollards with 1/4-inch-thick steel plate.

## 2.15 ABRASIVE METAL NOSINGS

- A. Cast-Metal Units: Cast iron, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. American Safety Tread Co., Inc.
    - b. Balco, Inc.

- c. Safe-T-Metal Company, Inc.
  - d. Wooster Products Inc.
- 2. Nosings: Cross-hatched units, 4 inches wide with 1-inch lip, for casting into concrete.
- 3. Nosings: Cross-hatched units, 1-1/2 by 1-1/2 inches, for casting into concrete.
- B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
- C. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
  - 1. Provide two rows of holes for units more than 5 inches wide, with two holes aligned at ends and intermediate holes staggered.
- D. Apply bituminous paint to concealed surfaces of cast-metal units.

#### 2.16 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Galvanize plates.
- C. Prime plates with zinc-rich primer.

#### 2.17 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

#### 2.18 STEEL WELD PLATES AND ANGLES

Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete

2.19 FINISHES, GENERAL

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.20 ALUMINUM FINISHES

A. Aluminum Surfaces

1. Surface Condition

- a. Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2. Unexposed Sheet, Plate, and Extrusions

- a. Unexposed sheet, plate, and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA 45, or AA 46.

2.21 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with universal shop primer unless zinc-rich primer is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Anchor supports for overhead doors and overhead grilles securely to, and rigidly brace from, building structure.

### 3.3 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
- C. Place removable bollards over internal sleeves and secure with 3/4-inch machine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.
- D. Fill bollards solidly with concrete, mounding top surface to shed water.
  - 1. Do not fill removable bollards with concrete.



3.4 INSTALLING NOSINGS, TREADS, AND THRESHOLDS

- A. Center nosings on tread widths unless otherwise indicated.
- B. For nosings embedded in concrete steps or curbs, align nosings flush with riser faces and level with tread surfaces.

3.5 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mildry film thickness.
- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099123 "Interior Painting."
- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000



## SECTION 057300 - DECORATIVE METAL RAILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exterior stainless-steel decorative railings with stainless-steel, wire-rope guard infill.
  - 2. Exterior stainless-steel handrails.
  - 3. Interior steel and iron decorative railings with stainless-steel, wire-rope guard infill.
- B. Related Sections:
  - 1. Division 05 Section "Pipe and Tube Railings" for railings fabricated from pipe and tube components.
  - 2. Division 06 Section "Rough Carpentry" for wood blocking for anchoring railings.

#### 1.3 DEFINITIONS

- A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis sealed by a qualified professional engineer registered in the State of North Carolina, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Stainless Steel: 60 percent of minimum yield strength.
  - 2. Steel: 72 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of railings assembled from standard components.
  - 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. For illuminated railings, include wiring diagrams and roughing-in details.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer registered in the State of North Carolina responsible for their preparation.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified professional engineer registered in the State of North Carolina.
- B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- C. Welding certificates.

#### 1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.6, "Structural Welding Code - Stainless Steel."

#### 1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.9 COORDINATION AND SCHEDULING

- A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not suit structural performance requirements.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, are to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

#### 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
  - 1. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.

#### 2.3 STAINLESS STEEL

- A. Tubing: ASTM A 554, Grade MT 316.

- B. Pipe: ASTM A 312/A 312M, Grade TP 316.
- C. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 316.
- D. Bars and Shapes: ASTM A 276, Type 316.
- E. Wire Rope and Fittings:
  - 1. Manufacturers: Subject to compliance with requirements,:
    - a. Cable Connection (The).
    - b. Carl Stahl DecorCable, Inc.
    - c. Esmet, Inc.
    - d. Feeney Wire Rope & Rigging.
    - e. Hayn Enterprises, LLC.
    - f. Johnson, C. Sherman, Co., Inc.
    - g. Loos & Co., Inc.; Cableware Division.
    - h. Ronstan International Inc.
    - i. Secosouth, Inc.
  - 2. Wire Rope: 7-by-19 wire rope made from wire complying with ASTM A 492, Type 316.
  - 3. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

## 2.4 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

## 2.5 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
  - 1. Stainless-Steel Components: Type 316 stainless-steel fasteners.
  - 2. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
  - 3. Dissimilar Metals: Type 316 stainless-steel fasteners.
- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
  - 1. Provide square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.6 MISCELLANEOUS MATERIALS

- A. Wood Rails: Clear, straight-grained hardwood rails secured to recessed metal subrail.
  1. Species: Maple.
  2. Finish: Transparent polyurethane.
  3. Staining: Match Architect's sample.
  4. Profile: As indicated.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- C. Low-Emitting Paints and Coatings: Paints and coatings applied to interior decorative metal railings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
  1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- F. Epoxy Intermediate Coat: Complying with MPI#77 and compatible with primer and topcoat.
- G. Polyurethane Topcoat: Complying with MPI#72 and compatible with undercoat.
- H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.7 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.
- D. Where wire-rope assemblies pass through steel posts, provide nylon bushings to prevent chafe.

- E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- F. Form work true to line and level with accurate angles and surfaces.
- G. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
- H. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- I. Connections: Fabricate railings with welded connections unless otherwise indicated.
- J. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- K. Form changes in direction as follows:
  - 1. As detailed.
- L. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- M. Close exposed ends of hollow railing members with prefabricated end fittings.
- N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- P. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.8 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.



- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.9 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
- C. Dull Satin Finish: No. 6.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

### 3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
- C. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For stainless-steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
  - 2. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.

### 3.5 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
  - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets to building construction as follows:
  - 1. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

### 3.6 CLEANING

- A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.
- B. Clean wood rails by wiping with a damp cloth and then wiping dry.
- C. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
  - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

### 3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Project Acceptance.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 057300

## SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Framing with dimension lumber.
  - 2. Wood blocking, cants, and nailers.
  - 3. Wood furring.
  - 4. Wood sleepers.
  - 5. Plywood backing panels.

- B. Related Requirements:

- 1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.
  - 2. Section 313116 "Termite Control" for site application of borate treatment to wood framing.

#### 1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

## 1.5 INFORMATIONAL SUBMITTALS

### A. Evaluation Reports: For the following, from ICC-ES:

1. Fire-retardant-treated wood.
2. Power-driven fasteners.
3. Post-installed anchors.
4. Metal framing anchors.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 WOOD PRODUCTS, GENERAL

- A. Regional Materials: Dimension lumber, except treated materials, shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
  3. Dress lumber, S4S, unless otherwise indicated.
- C. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

## 2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.[ Do not use inorganic boron (SBX) for sill plates.]
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
1. Wood nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Treatment shall not promote corrosion of metal fasteners.
  2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  3. Interior Type A: Treated materials shall have a moisture content of 15 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.
  5. Kiln dry treated lumber to the required moisture level after treatment.
- C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- D. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- E. Application: Treat items indicated on Drawings, and the following:
1. Framing for raised platforms.
  2. Concealed blocking.
  3. Plywood backing panels.

#### 2.4 DIMENSION LUMBER FRAMING

1. Hem-fir (north); NLGA.
  2. Mixed southern pine or southern pine; SPIB.
  3. Spruce-pine-fir; NLGA.
  4. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
  5. Eastern softwoods; NeLMA.
- B. Other Framing: No. 2 grade of any of the following species:
1. Hem-fir (north); NLGA.
  2. Southern pine; SPIB.
  3. Southern pine or mixed southern pine; SPIB.
  4. Spruce-pine-fir; NLGA.

#### 2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
  2. Nailers.
  3. Rooftop equipment bases and support curbs.
  4. Furring.
  5. Utility shelving.
  6. Hem-fir (north); NLGA.

7. Mixed southern pine or southern pine; SPIB.
  8. Spruce-pine-fir; NLGA.
  9. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
  10. Eastern softwoods; NeLMA.
- B. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:
1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
  2. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
  3. Eastern softwoods, No. 2 Common grade; NELMA.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

## 2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C , fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

## 2.7 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

## 2.8 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
  1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.



2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
  3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
  4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
  2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- K. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
  3. ICC-ES evaluation report for fastener.
- L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- 3.2 WOOD BLOCKING AND NAILER INSTALLATION
- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

### 3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring horizontally at 24 inches o.c.

### 3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

## SECTION 061600 - SHEATHING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

Wall sheathing.

- 1. Sheathing joint and penetration treatment.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for plywood backing panels.

#### 1.3 ACTION SUBMITTALS

Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

### 2.2 WALL SHEATHING

Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:

CertainTeed Corporation; GlasRoc.

- a. Georgia-Pacific Building Products; Dens-Glass Gold.
- b. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
- c. Temple-Inland Building Products by Georgia-Pacific; GreenGlass Exterior Sheathing.
- d. United States Gypsum Co.; Securock.

2. Type and Thickness: Regular, 1/2 inch thick.

3. Size: 48 by 120 inches for vertical installation.

### 2.3 FASTENERS

General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

Wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

- A. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
  2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

## 2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
  2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
  3. ICC-ES evaluation report for fastener.
- D. Coordinate wall and parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

### 3.2 WOOD STRUCTURAL PANEL INSTALLATION

General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

- A. Fastening Methods: Fasten panels as indicated below:

Parapet Sheathing:

- Screw to cold-formed metal framing.
- a. Space panels 1/8 inch apart at edges and ends.

### 3.3 GYPSUM SHEATHING INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.

Fasten gypsum sheathing to cold-formed metal framing with screws.

1. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
2. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

- B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

- C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

- D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

- E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

## SECTION 061719 - CROSS-LAMINATED TIMBER

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Delegated design.
  - 2. Cross-Laminated Timber (CLT-#) panels.
  - 3. Connectors, fasteners and other installation accessories.
  - 4. Shop-fabrication, including shop machining for connectors.
  - 5. Shop-applied finishes.
  - 6. Erection.
  - 7. Cleaning.

#### 1.3 DEFINITIONS

- A. AOR: Architect of Record.
- B. CLT: A prefabricated engineered wood product made of at least three orthogonal layers of graded sawn lumber or structural composite lumber (SCL) that are laminated by gluing with structural adhesives.
- C. CLT Manufacturing: The process of assembling longitudinal and transverse layers of lumber with structural adhesives to form rectangular panels of specified length, width, and thickness, for use as roof, wall or floor panels.
- D. CLT Fabrication: The cutting and tooling of manufactured CLT panels to exact dimensions and detailing required for final assembly in the project.
- E. NLGA: The National Lumber Grades Authority (Canada).
- F. SEOR: Structural Engineer of Record for the project.
- G. SSEOR: Specialty Structural Engineer of Record for design of CLT panels.

#### 1.4 REFERENCES

- A. ANSI/APA PRG 320 - Standard for Performance-Rated Cross-Laminated Timber; current version.
- B. ANSI 405 - Standard for Adhesives for Use in Structural Laminated Timber; current version.
- C. CLT Certification Agencies:
  - 1. TECO - PFS Corporation d/b/a PFS TECO; [www.pfsteco.com](http://www.pfsteco.com).

2. Intertek; [www.intertek.com](http://www.intertek.com).

- D. DIN EN 301 – Adhesives, phenolic and Aminoplastic, for Load-Bearing Timber Structures – Classification and Performance Requirements.
- E. DIN EN 302 – Adhesives for Load-Bearing Timber Structures – Test Methods.
- F. DIN 68141 – Wood Adhesives – Determination of the Open Drying Time and Evaluation of Wetting and Brushability.
- G. National Design Specification (NDS) for Wood Construction; current version.
- H. National Lumber Grades Authority (NLGA) – NLGA Standard Grading Rules for Canadian Lumber.
- I. PEFC - Programmed for the Endorsement of Forest Certification; [www.pefc.co.uk](http://www.pefc.co.uk).

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. APA Product Certificate per APA PRG 320.
  - 2. Test Reports: For 1-hour and 2-hour rated panels and assembly details, as applicable to Project.
- B. Coordination Model:
  - 1. Supplier shall provide an accurate three-dimensional (3D) digital model of CLT geometry that captures the following:
    - a. Geometry of all interfaces with related structural components such as steel construction and concrete construction.
    - b. Coordinated CLT geometry with mass plywood panel shop drawings in Section 06 17 21 “Mass Plywood Panels” and glulam shop drawings in Section 06 18 00 “Glued-Laminated Construction.”
    - c. Alignment with the supplier’s manufacturing and fabrication capabilities.
  - 2. Supplier shall provide the digital model in a format that is compatible for AOR’s review and coordination with trades involved. Acceptable formats include but are not limited to (.SAT) (.IFC) (.DWG) (.DFX) (.RVT).
- C. Shop Drawings:
  - 1. Supplier to provide 2D shop drawings that track the increased Level of Detail (LOD) throughout the submittal process in the following order:
    - a. LOD300 Slab Plans and Connections: Provide floor plans clearly showing the extents of all mass timber slabs in relation to gridlines, relevant structural trades and finish conditions found in the Contract Documents. Indicate how slab edge locations are to comply with erection and fabrication tolerances with relevant trades as stated in their respective spec sections. Indicate areas of confusion not clearly shown in Contract Documents, provide detail drawings indicating all unique bearing conditions, fastener spacing and requested tolerances for installation.
    - b. LOD350 Panel Layout and MEPF Sleeves: Provide floor plans indicating panel layout and all coordinated penetrations. Clearly dimension all sleeves, diameter and



location from adjacent panel edges. Clearly dimension panel layout and propose panel numbering to be utilized for installation. State information listed in subparagraph c, LOD400, for unique groups of panel conditions. The acceptance of this submittal will serve as Approval for Fabrication.

- c. LOD400 Single Piece Shop Drawings for Record: Documentation of each unique panel clearly stating the following information:
  - 1) Stress Grade, Service Grade, Finish Grade.
  - 2) Span direction.
  - 3) Lifting connection points.
  - 4) Panel thickness and layup.
  - 5) Edge conditions.
  - 6) Overall and penetration dimensions.
  - 7) North Arrow.
  - 8) Panel production number.

D. Method Statements:

- 1. Rigging Plan: Describe lifting and handling requirements for each different panel type, taking into consideration openings and cut-outs in panels.

E. Weather and Moisture Protection Plan: Submit proposed coverings and removal sequence, and standing water mitigation plan during construction, as applicable.

F. Samples:

- 1. Submit three (3) samples of lumber, approximately 12 inches long, for each required species comprising CLT panel layup.
- 2. Submit three (3) samples of CLT panels, approximately 12 by 12 inches for each thickness required, with shop-applied finish coating.

G. Sustainable Design Submittals: Refer to Section 01 81 13 "Sustainable Design Requirements."

- 1. MR Credit 3 - BPDO, Sourcing of Raw Materials:
  - a. Certified Wood: Documentation indicating percentage new wood, percentage Forest Stewardship Council (FSC) and Chain-of-Custody (CoC) certificates for manufacturer and vendor. Include vendor invoice indicating FSC and CoC.
  - b. Pilot Alternative Compliance Path - Legal Wood: Documentation of wood products from Certified Sources as defined by ASTM D7612 meeting following requirements:
    - 1) 100 percent of all wood is verified to be from Legal (non-controversial) Sources as defined by ASTM D7612.
    - 2) 70 percent of all wood used on the Project is from Responsible Sources as defined by ASTM D7612.
- 2. MR Credit 4 - BPDO, Material Ingredients:
  - a. Material Ingredient Report.

3. IEQ Credit 2 - Low-Emitting Materials:

- a. Interior Wet-Applied Coatings, Adhesives, Sealants, Grouts and Primers: Certificate stating compliance with California Department of Public Health (CDPH) Standard Method V1.1-2010, including total volatile organic compounds (TVOC) range.
  - 1) Include product data stating VOC content in g/L.
  - 2) Include volume of material applied per product.
- b. Composite Wood Installed Within the Building Interior: Certificate stating compliance with California Air Resources Board (CARB) Airborne Toxic Control Measures (ATCM), Phase II for ultra-low-emitting formaldehyde (ULEF) resins or product data stating product does not contain added formaldehyde resins.

H. Quality Assurance Submittals:

1. Manufacturer's qualifications.
2. Quality Assurance (QA) and Quality Control (QC) log.
3. Preinstallation conference minutes.

1.6 QUALITY ASSURANCE

A. Material Standard: Certify CLT panels to APA PRG 320.

B. Manufacturer's Qualifications:

1. Certification: Manufacturer shall be certified by the American Plywood Association - Engineered Wood Systems (APA EWS), PFS TECO, or Intertek.
2. Design Standards: Manufacturer shall comply with the National Design Specification for Wood Construction - NDS, applicable to types of CLT panels indicated.
3. Compliance with adhesive manufacturer's written recommendations.

C. The fabricator shall keep a Quality Control (QC) log of items, including the following:

1. Environmental conditions at all stages, including fabrication and storage.
2. Actual length, thickness, and width of the panels.
3. Hardware and fastener installation sign-off.
4. Note of any changes or modifications.

D. The erector shall keep a Quality Control (QC) log of items, including the following:

1. Environmental conditions at all stages, including storage, transportation, and erection.
2. Hardware and fastener installation sign-off.
3. Note of any changes or modifications.

E. Preinstallation Conference: Conduct conference at Project site.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow.

2. Notify Owner's representative, AOR, SEOR, SSEOR and testing agency of scheduled meeting dates.

- F. Forest Certification: Provide wood products made from forests certified by an FSC-accredited certification body or USGBC-approved equivalent.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect CLT panel during delivery, storage and handling.
- B. Support units during shipment on non-staining material in same position as during storage.
- C. Store units with adequate bracing and protect units to prevent contact with soil and separated with stripping, so air may circulate around all faces of CLT panels. Take actions to prevent staining, cracking, distortion, warping or other physical damage.
  1. Place stored units so identification marks are clearly visible.
  2. Handle and transport units in a position consistent with their shape and design to avoid excessive stresses that would cause cracking or damage. Protect corners with wood blocking.
  3. Lift and support units only at designated points shown on Shop Drawings.
  4. Slit underside of membrane covering during storage at site to avoid accumulation of condensation or moisture. Take care to not deface underside surface of CLT panels.
  5. If factory coverings have been removed, cover top and sides with opaque moisture resistant membrane.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Bracing and Temporary Shoring: Follow installation method statement and bracing plan, including evaluation of temporary loading conditions and bracing of structure during installation.
- B. Manufacturer shall have APA PRG 320 certification for all layups required by the Contract Documents.
- C. Manufacturer's panels shall meet or exceed the minimum design values as required in the Contract Documents or as required by SSEOR.
- D. Fire-Rated Assemblies: Manufacturer shall provide testing reports showing that their panels can perform to the requirements of the Project, or demonstrate analysis based on fire testing of similar panels that the manufacturer makes. Analysis shall include a load analysis of the design loads required for the Project.

#### 2.2 MATERIALS

- A. Wood Species:
  1. Provide minimum or better grades as specified in APA PRG 320; for laminated stock for Cross-Laminated Timber (CLT) panels.
  2. Acceptable Species:
    - a. Southern Yellow Pine.

- B. Adhesives: Provide adhesive products in compliance with ANSI 405 and APA PRG 320 or, DIN 68141, DIN EN301 and DIN EN302; to grade of service required in accordance with NDS.

## 2.3 PRESERVATIVE TREATMENT

- A. Preservative Treatment: Where preservative-treated cross-laminated timber is indicated on drawings, or in damp or humid service conditions, use preservative treated wood.
  - 1. Use preservative solution without substances that might interfere with application of indicated finishes.
  - 2. Pressure impregnate preservative treated wood with an approved process for the location in accordance with AITC 109 or APA EWS S580D, AWWA T1, and AWWA U1. Any strength or stiffness reduction due to treatment must be provided by the treater. Kiln dry all wood after treatment to remove the moisture added during treatment. Moisture content throughout material after drying must be less than 15 percent.

## 2.4 ACCESSORIES

- A. Fasteners:
  - 1. Spline:
    - a. Basis-of-Design at Roof Panels:
      - 1) MDSS96 strapping with 1/4-inch by 1-1/2-inch SDS screws; spacing per Contract Documents or as required by SSEOR.
      - 2) Manufacturer: Simpson Strong-Tie.
  - 2. Fasteners:
    - a. Spline Fastener Basis-of-Design at Roof Panels:
      - 1) 1/4-inch by 1-1/2-inch SDS screws; spacing per Contract Documents or as required by SSEOR.
      - 2) Manufacturer: Simpson Strong-Tie.
    - b. Bearing Screw (CLT connection to glulam structure):
      - 1) SDCP Timber Screw, sizing and spacing per Contract Documents or as required by SSEOR.
      - 2) Manufacturer: Simpson Strong-Tie.
- B. Wrapping Material: Weatherproof and lightproof material that will not adversely affect panels.
- C. Seal Tape at Panel Joints and Ends: For protection of CLT panels from movement of water down through mass timber system and from moisture at concrete during topping slab placement and curing.
  - 1. Basis-of-Design Product: 6-inch wide Stego-Crete Claw Tape by Stego Industries, LLC; [www.stegoindustries.com](http://www.stegoindustries.com).

## 2.5 MANUFACTURING

- A. Manufacture CLT panels in accordance with APA PRG 320.
- B. Manufacture panels in a temperature-controlled facility. Pre-heating lamination stock is not permitted.
- C. Standard Laminations: Use multiple layers of 5/8 inch (16 mm) minimum to 2 inches (51 mm) maximum thick laminations.
- D. Appearance Classifications: Provide CLT panels meeting Appendix A of APA PRG 320 and the following additional requirements:
  - 1. Architectural Appearance Classification: Locations where CLT panels are exposed to view in final construction.
    - a. Blue-stain/ beetle-kill lumber material is allowed up to 5 percent of visual surface.
    - b. Knots: NLGA Grade Rule; Select Structural limitation, Select Tight Knot.
    - c. Pitch Streaks: Pitch streaks are not permitted.
    - d. Wane: Wane on face is not permitted.
    - e. Side pressure on exposed faces is required.
  - 2. Industrial Appearance Classification: For locations where CLT panels are concealed from view.
    - a. Staining: Heart and/or blue stain are allowed up to 5 percent of visual surface.
    - b. Shake and checks: Allowed; shall not exceed 36 inches or 1/4 of the panel length.
    - c. Knots: Knots shall be well-spaced, quantity not limited.
    - d. Wane: Minimal wane on face is permitted.
    - e. Side pressure on exposed face is not required.
- E. Tolerances:
  - 1. Height: Plus or minus 5/64-inch (2 mm) or 2 percent of panel thickness, but not exceeding 1/8 inch (3 mm).
  - 2. Width: Plus or minus 1/8 inch (3 mm).
  - 3. Length: Plus or minus 1/4 inch (6 mm).
  - 4. Squareness: The length of two panel face diagonals measured between panel corners shall not differ by more than 1/8 inch (3 mm).
  - 5. Straightness: Deviation of edges from straight line between adjacent panel corners shall not exceed 1/16 inch.

## 2.6 FABRICATION

- A. Fabricate panels with approved splice connection details, as indicated in Contact Documents.
- B. Joints: Route CLT panels along edges for continuous spline as indicated in shop drawings.
- C. Chamfers: Not permitted.

- D. Identification: Mark CLT panels for identification during erection.
  - 1. Clearly mark top surface of panels with the following:
    - a. Length, width, thickness and diagonal measurement.
    - b. Tolerances as per these specifications.
    - c. Provide stamp for plan North on the top of each panel along the North edge.

## 2.7 FINISHES

- A. Shop-Applied Edge Sealer:
  - 1. Apply protective coating to CLT panels within an enclosed, weather-protected finishing and storage space.
  - 2. Protective Coating: Apply two coats of protective coating to all penetrations, holes, opening, and perimeter edges of panels.
    - a. Basis-of-Design Product: KP-12 UVW by Sansin Corp.; [www.sansinfactoryfinish.com](http://www.sansinfactoryfinish.com).
    - b. Or approved substitution.
- B. Field-Applied Final Finish, Exterior and Interior Applications: Coordinate with final field-applied finish stain and seal in accordance with Section 09 91 00 "Painting"

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Prior to site erection, examine site conditions and ensure acceptable conditions for erection.
- B. Examine locations to receive CLT for compliance with requirements, tolerances and other conditions affecting performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with installation method statement and bracing plan.
- B. Erect CLT panels in accordance with engineered rigging plans and in coordination with shop drawings.
- C. Make adequate provision for possible erection stresses. Set CLT panels level and plumb to correct positions. Securely brace CLT panels and anchor in place to maintain plumb until permanently secured by finished structure.
- D. Fit CLT panels closely and accurately, without trimming, cutting or other modifications.
  - 1. Site cutting or boring of CLT panels, other than shown on shop drawings is not permitted without written consent of SSEOR, SEOR and AOR.
- E. Join CLT panels along edges using a continuous spline as indicated in shop drawings.
  - 1. Gap between adjacent CLT panels: 1/8-inch.

3.3 FINISHING

- A. Field Finishing: Stain and seal in accordance with Section 09 93 00 “Staining and Transparent Finishing”
  - 1. Applications: Finish occurs at the following locations:
    - a. All exterior exposed conditions.
    - b. Interior exposed conditions as indicated.

3.4 CLEANING

- A. Clean exposed surfaces of CLT panels after erection and completion of field touch up.
  - 1. Clean all exposed surfaces.
  - 2. Perform cleaning procedures, as necessary, according to CLT manufacturer’s written recommendations and as instructed by AOR. Protect other work from staining or damage due to cleaning operations.
  - 3. Do not use cleaning materials or processes that could change the appearance of exposed CLT panels or damage adjacent materials.

3.5 ADJUSTING AND PROTECTION

- A. Protect installed panels from damage during construction.
- B. Prevent standing water on panel faces.
- C. Remove panel protection immediately prior to installation.

END OF SECTION 061719





## SECTION 061800 - GLUED-LAMINATED CONSTRUCTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Framing using structural glued-laminated timber.

- B. Related Requirements:

- 1. Section 061719 "Cross Laminated Timber" for Roof Decking.

#### 1.3 DEFINITIONS

- A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include data on lumber, adhesives, fabrication, and protection.
  - 2. For preservative-treated wood products. Include chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
  - 3. For connectors. Include installation instructions.

- B. Shop Drawings:

- 1. Show layout of structural glued-laminated timber system and full dimensions of each member.
  - 2. Indicate species and laminating combination.
  - 3. Include large-scale details of connections.

- C. Samples: Full width and depth, 24 inches long, showing the range of variation to be expected in appearance of structural glued-laminated timber.

1. Apply specified factory finish to three sides of half length of each Sample.

- D. Delegated-Design Submittal: For structural glued-laminated timber and timber connectors.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.
- B. Material Certificates: For preservative-treated wood products, from manufacturer. Indicate type of preservative used and net amount of preservative retained.
- C. Research/Evaluation Reports: For structural glued-laminated timber and timber connectors, from ICC-ES.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: An AITC- or APA-EWS-licensed firm.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water-resistant seams.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design structural glued-laminated timber and connectors.
- B. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D3737 and acceptable to authorities having jurisdiction.

## 2.2 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction.

1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
2. Provide structural glued-laminated timber made from single species.
3. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
4. Provide structural glued-laminated timber made with wet-use adhesive complying with AITC A190.1.

B. Species and Grades for Structural Glued-Laminated Timber: Southern pine

C. Species and Grades for Beams and Purlins:

1. Species and Beam Stress Classification: Southern pine, 24F-1.8E

D. Species and Grades for Columns:

1. Species and Combination Symbol: Southern pine, 47.

E. Appearance Grade: Architectural complying with AITC 110.

1. For Architectural appearance grades, fill voids as required by AITC 110.

## 2.3 PRESERVATIVE TREATMENT

A. Preservative Treatment: Where preservative-treated structural glued-laminated timber is indicated, comply with AWPA U1, Use Category 3A

1. Use preservative solution without substances that might interfere with application of indicated finishes.
2. Do not incise structural glued-laminated timber or wood used to produce structural glued-laminated timber.

B. One of the following Preservatives:

1. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.
2. Pentachlorophenol in light petroleum solvent.
3. Copper naphthenate in a light petroleum solvent.
4. Ammoniacal zinc copper arsenate (ACZA) in a water solution.
5. Chromated copper arsenate (CCA) in a water solution.
6. Ammoniacal copper quat Type A (ACQ-C) in a water solution.
7. Propiconazole tebuconazole imidacloprid (PTI) in a water emulsion.

C. After dressing members, apply a copper naphthenate field-treatment preservative to comply with AWPA M4 to surfaces cut to a depth of more than 1/16 inch.

## 2.4 TIMBER CONNECTORS

- A. Fabricate beam seats from stainless steel with bearing plates, and side plates.
- B. Fabricate arch base shoes from stainless steel with baseplates and side plates.
- C. Fabricate hinge connectors from stainless steel with side plates and top and bottom plates or slotted concealed plates as indicated on drawings.
- D. Fabricate tie rods from round steel bars with upset threads connected with forged-steel turnbuckles complying with ASTM A668/A668M.
- E. Provide bolts, 3/4 inch unless otherwise indicated, complying with ASTM A307, Grade A; nuts complying with ASTM A563; and, where indicated, flat washers.
- F. Provide shear plates, complying with ASTM D5933.
- G. Materials: Unless otherwise indicated, fabricate from the following materials:
  - 1. Structural-steel shapes, plates, and flat bars complying with ASTM A36/A36M.
  - 2. Round steel bars complying with ASTM A575, Grade M 1020.
  - 3. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.
  - 4. Stainless steel flat bars complying with ASTM A666, Type 304.
  - 5. Stainless steel bars and shapes complying with ASTM A276, Type 304.
  - 6. Stainless steel plate, sheet, and strip complying with ASTM A240/A240M or ASTM A666, Type 304.
- H. Finish steel assemblies and fasteners with rust-inhibitive primer, 2-mil dry film thickness.
- I. Hot-dip galvanize steel assemblies and fasteners after fabrication to comply with ASTM A123/A123M or ASTM A153/A153M.

## 2.5 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

## 2.6 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.

1. Dress exposed surfaces as needed to remove planning and surfacing marks.
- B. Camber: Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/500 of span.
- C. Where preservative-treated members are indicated, fabricate (cut, drill, surface, and sand) before treatment to greatest extent possible. Where fabrication must be done after treatment, apply a field-treatment preservative to comply with AWP M4.
  1. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
  2. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- D. End-Cut Sealing: Immediately after end cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- E. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit except for preservative-treated wood where treatment included a water repellent.

## 2.7 FACTORY FINISHING

- A. Wiped Stain Finish: Manufacturer's standard, dry-appearance, penetrating acrylic stain and sealer; oven dried and resistant to mildew and fungus.
  1. Color: As indicated on Architectural drawings or as selected by Architect from manufacturer's full range
- B. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
  - 1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Framing Built into Masonry: Provide 1/2-inch clearance at tops, sides, and ends of members built into masonry; bevel cut ends 3 inches; and do not embed more than 4 inches unless otherwise indicated.
- C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- D. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.
  - 1. Predrill for fasteners using timber connectors as templates.
  - 2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
  - 3. Coat cross cuts with end sealer.
  - 4. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWP A M4.
    - a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
    - b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- E. Install timber connectors as indicated.
  - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
  - 2. Install bolts with orientation as indicated or, if not indicated, as directed by Architect.

### 3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

### 3.4 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.

1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION 061800





## SECTION 062013 - EXTERIOR FINISH CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Lumber siding.
  - 2. Attachment Support Framing System - Z Girt Support System
- B. Related Requirements:
  - 1. Division 06 Section "Rough Carpentry" for other carpentry work not exposed to view.
  - 2. Section 042000 "Unit Masonry"
  - 3. Section 055000 – "Cold-Formed Metal Framing"
  - 4. Section 072100 "Thermal Insulation"
  - 5. Section 072726 "Fluid Applied Membrane Air Barrier."

#### 1.3 ACTION SUBMITTALS

- A. Samples for Verification:
  - 1. For each species and cut of lumber and panel products, with 1/2 of exposed surface finished; 50 sq. in. for lumber and 8 by 10 inches for panels.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Compliance Certificates:
  - 1. For lumber that is not marked with grade stamp.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

#### 1.6 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## 1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups for typical exterior wall in sizes approximately 10'-0" long by 10'-0" high by full thickness.
    - a. Include a window opening. Make opening approximately 24 inches wide by 24 inches high. Include all flashings.
    - b. Include weather barrier, insulation and finish siding for a complete wall system.
    - c. Include coping and rainscreen ventilation.
  2. Protect accepted mockups from the elements with weather-resistant membrane.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
  4. Coordinate construction of the wall mockup with other trades including framing, sheathing, thermal insulation, air barriers and window contractors.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Regional Materials: The following wood products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.
1. Exterior lumber siding.
- B. Lumber: DOC PS 20 and the following grading rules:
1. Select grade: Select is the highest quality available. Small pin knots not to exceed 1/4" in diameter are permitted. Sapwood is not a defect. Three(3) light surface checks not to exceed 3-7 inches long and 1/32" wide.
  2. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
  3. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

### 2.2 EXTERIOR TRIM

- A. Lumber Trim for Clear Finish:
1. Species and Grade: Atlantic White Cedar, Select.
  2. Maximum Moisture Content: 15 percent.
  3. Finger Jointing: Not allowed.
  4. Face Surface: Surfaced (smooth).

### 2.3 LUMBER SIDING

- A. Provide kiln-dried lumber siding complying with DOC PS 20.
- B. Species and Grade: Atlantic White Cedar; Select.
- C. Pattern: Shiplap - 1/2 Lap, nominal width and thickness of 8 by 1 inch (actual dimensions of approx. 7 1/2 x 3/4 inch), measured at 15 percent moisture content.
- D. Finishes for wood siding: Factory finish with transparent water repellent wood preservative for all exterior siding shall be applied to all surfaces, including front, back, and edges prior to installation. A finish coat shall be applied to all siding after installation.
  - 1. Manufacturers:
    - a. Cabot: Australian Timber Oil.
    - b. Olympic: Maximum Toner Waterproofing Sealant.
    - c. Thompson's: Water Seal: Advanced Tinted Wood Protector.
  - 2. Color: Natural cedar stain.

## 2.4 MISCELLANEOUS MATERIALS

- A. Rainscreen Clips: "H" or proprietary shaped extruded aluminum clip designed for hidden attachment of ventilated rainscreen siding.
- B. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
  - 1. For applications not otherwise indicated, provide stainless-steel fasteners.
- C. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.
- D. Flashing: Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.
  - 1. Horizontal Joint Flashing for Panel Siding: Preformed, stainless-steel, Z-shaped flashing.
- E. Sealants: Latex, complying with ASTM C 834 Type OP, Grade NF and with applicable requirements in Division 07 Section "Joint Sealants," recommended by sealant manufacturer and manufacturer of substrates for intended application.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolac.
    - b. Bostik, Inc.; Chem-Calk 600.
    - c. May National Associates, Inc.; Bondaflex 600.
    - d. Pecora Corporation; AC-20+.
    - e. Schnee-Morehead, Inc., an ITW company; SM 8200.
    - f. Tremco Incorporated; Tremflex 834.

## 2.5 ATTACHMENT SUPPORT FRAMING SYSTEM:

- A. Basis of Design Products: Subject to compliance with requirements, provide SMARTci Basic fiberglass reinforced GREENgirt composite framing support system by Advanced Architectural Products, Inc.

- B. System Performance: Constructed system must comply with ANSI ASHRAE 90.1-2007 definition for continuous insulation (c.i.).
- C. Wind Load Performance - Attachment system must show the following minimum results when tested in accordance with ASTM E330-02.
  - 1. 90 pound per square foot negative and positive pressure held for 60 seconds, system components shall not experience failure or gross permanent distortion.
  - 2. 135 pound per square foot negative and positive pressure held for 10 seconds, system components shall not experience failure or gross permanent distortion.
- D. Water penetration/ Air Leakage Performance - Attachment system substrate fasteners must show the following results when tested in accordance with ASTM E331-00 and ASTM E283-04.
  - 1. No water leakage seen on tested attachment system, specifically including substrate fasteners when tested up to 20 pounds per square foot pressure differential.
  - 2. Less than 0.01 cubic feet per minute per square foot air leakage through entire tested system at 1.6 and 6.2 pounds per square foot.
- E. Wind cycling (air pressure cycling) performance - Attachment system must show conformance to the following results when tested in accordance with ASTM E1886-05.
  - 1. A total of 4,500 air pressure cycles. Cycles must include 50 cycles at a maximum pressure of 90 pounds both positive and negative. Average cycle time must not be less than 3.25 seconds for both negative and positive cycles. No damage or deformation must be seen at end of test.
- F. Spacing to comply with applicable live and dead loads and any other requirements of the facade/panel and in accordance with the applicable building code, as indicated in the approved delegated design calculations.
- G. Galvanic Protection: Utilize tapes, gaskets and other methods as necessary to separate and prevent contact between dissimilar metals throughout.

## 2.6 FABRICATION

- A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.
- B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

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

### 3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Division 09 Section "Exterior Painting."

### 3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
- B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

### 3.4 SIDING INSTALLATION

- A. Horizontal Lumber Siding: Install vertical furring at 16" o. c. Align vertical furring with cold-formed metal wall framing as required. Install rainscreen system siding clips at wall base as indicated so that initial course is level with lower edge of siding covering the substrate.. Fasten at each furring strip with stainless steel fasteners.
  - 1. Leave 1/8-inch gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
  - 2. Butt joints only over furring or blocking, staggering joints randomly in subsequent courses so that joints in any 3 consecutive courses align.
  - 3. Seal all field cut siding with water repellent wood preservative as recommended by the siding manufacturer.
- B. Flashing: Install metal flashing as indicated on Drawings and as recommended by siding manufacturer.
- C. Finish: Apply final finish coat of water repellent wood preservative within two weeks of installation.

### 3.5 ADJUSTING

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

### 3.6 CLEANING

- A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
  - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062013

## SECTION 062023 - INTERIOR FINISH CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Interior plywood paneling.

- B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
  - 2. Section 099123 "Interior Painting" for priming and backpriming of interior finish carpentry.

#### 1.3 DEFINITIONS

- A. MDF: Medium-density fiberboard.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
  - 2. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
  - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
- B. Samples for Verification:

1. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. for lumber and 8 by 10 inches for panels.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.
- B. Sample Warranty: For manufacturer's warranty.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry materials only when environmental conditions comply with requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions comply with requirements specified for installation areas.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
  1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS, GENERAL

- A. Regional Materials: The following wood products shall be manufactured from materials that have been extracted, harvested, or recovered within 100 miles of the Project site.
  1. Interior trim.
  2. Interior plywood paneling.
  3. Shelving.



- B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's Board of Review. Grade lumber by an agency certified by the American Lumber Standard Committee's Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. For exposed lumber, mark grade stamp on end or back of each piece.
- C. Softwood Plywood: DOC PS 1.
- D. Hardboard: ANSI A135.4.
- E. MDF: ANSI A208.2, Grade 130.
- F. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

## 2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: For applications indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and comply with testing requirements; testing will be conducted by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
  - 1. Kiln dry lumber and plywood after treatment to a maximum moisture content of 19 and 15 percent, respectively.
- C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not contain colorants, and provide materials that do not have marks from spacer sticks on exposed face.
- D. Do not use material that does not comply with requirements for untreated material or is warped or discolored.
- E. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
  - 2. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.
- F. Application: Insert application.

## 2.3 INTERIOR TRIM

### A. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Red oak White maple, Clear A Finish B Finish; NHLA.
2. Maximum Moisture Content: 13 percent.
3. Gluing for Width: Use for lumber trim wider than 6 inches.
4. Face Surface: Surfaced (smooth).
5. Matching: Selected for compatible grain and color.

### B. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Eastern white pine, D Select; NeLMA or NLGA.
2. Maximum Moisture Content: 15 percent.
3. Finger Jointing: Allowed.
4. Face Surface: Surfaced (smooth).

## 2.4 PANELING

### A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Columbia Forest Products.
  - b. Eggers Industries.
  - c. Georgia-Pacific Building Products.
2. Face Veneer Species and Cut: Insert species and cut.
3. Veneer Matching: Selected for similar color and grain.
4. Backing Veneer Species: Any hardwood compatible with face species.
5. Construction: Veneer core.
6. Thickness: 7/16 inch.
7. Panel Size: 48 by 96 inches.
8. Glue Bond: Type II (interior).
9. Finish: Manufacturer's standard, transparent, UV-resistant, protective finish.

## 2.5 FABRICATION

### A. Back out or kerf backs of the following members, except those with ends exposed in finished work:

1. Interior standing and running trim, except shoe and crown molds.
2. Wood-board paneling.

- B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

#### 3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound; warped; improperly treated or finished; inadequately seasoned; too small to fabricate with proper jointing arrangements; or with defective surfaces, sizes, or patterns.
- B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
  - 3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
  - 4. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.
  - 5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

### 3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
  - 1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
  - 2. Install trim after gypsum-board joint finishing operations are completed.
  - 3. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

### 3.5 PANELING INSTALLATION

- A. Plywood Paneling: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Leave 1/4-inch gap to be covered with trim at top, bottom, and openings. Install with uniform tight joints between panels.
  - 1. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners and adhesive as recommended by panel manufacturer.
  - 2. Conceal fasteners to greatest practical extent.
  - 3. Arrange panels with grooves and joints over supports. Fasten to supports with nails of type and at spacing recommended by panel manufacturer. Use fasteners with prefinished heads matching groove color.

### 3.6 ADJUSTING

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

### 3.7 CLEANING

- A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes if any.

### 3.8 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.

- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
  - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 062023



## SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.
2. Section 123661.16 "Solid Surfacing Countertops and Fabrications"

#### 1.2 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Miscellaneous materials.

B. Product Data Submittals: For each product.

C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.
5. Apply AWI Quality Certification Program label to Shop Drawings.

- D. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.
- E. Samples for Initial Selection: For each type of exposed finish.
- F. Samples for Verification: For the following:
  - 1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.
  - 2. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
  - 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Licensed participant in AWI's Quality Certification Program.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

#### 1.7 FIELD CONDITIONS

- A. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.



1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

## PART 2 - PRODUCTS

### 2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
  1. Provide labels and certificates from AWI certification program indicating that woodwork and installation complies with requirements of grades specified.
    - a. This Project has been registered with AWI as AWI Quality Certification Program Number #.
- B. Architectural Woodwork Standards Grade: Custom grade except as noted. Premium Grade for reception casework.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: ISO 4586-3, grades as indicated or if not indicated, as required by quality standard.
  1. Subject to compliance with requirements, provide products indicated on drawings.
- F. Exposed Surfaces:
  1. Plastic-Laminate Grade: HGS (horizontal surfaces), VGS (vertical surfaces).
  2. Edges: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.
  3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels unless otherwise indicated.
- G. Semiexposed Surfaces:
  1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, ISO 4586-3.
    - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 3.0 mm thick, matching laminate in color, pattern, and finish.

- b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, ISO 4586-3, grade to match exposed surface.
- 2. Drawer Sides and Backs: Solid-hardwood lumber.
  - 3. Drawer Bottoms: Hardwood plywood.
- H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.
- I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, ISO 4583-3, grade to match exposed surface.
- J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- K. Colors, Patterns, and Finishes: Provide materials and products as indicated on drawings.

## 2.2 WOOD MATERIALS

- A. Products shall be made without urea formaldehyde.
- B. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 8 to 13 percent.
- C. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Softwood Plywood: DOC PS 1.

## 2.3 CABINET HARDWARE AND ACCESSORIES

- A. Cabinet Hardware: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 170 degrees of opening, self-closing.
- C. Back-Mounted Pulls: ADA compliant 8" satin stainless steel linear pull. Basis of design: Mockett #DP55C.

- D. Adjustable Shelf Standards and Supports: Mortise mount 23 gauge steel pilaster standards with steel shelf support clips; BHMA Grade 1 compliant.
- E. Drawer Slides: ANSI/BHMA A156.9.
  - 1. Standard Duty (Grade 1 and Grade 2): Side mount.
  - 2. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.
    - a. Type: Full extension.
    - b. Material: Zinc-plated ball bearing slides.
  - 3. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50-lb load capacity.
  - 4. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
  - 5. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
  - 6. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
  - 7. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
- F. Door Locks: ANSI/BHMA A156.11, E07121.
- G. Drawer Locks: ANSI/BHMA A156.11, E07041.
- H. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
  - 1. Color: White.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
  - 1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Architect's sample.
  - 2. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
  - 3. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
  - 4. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
  - 5. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
  - 6. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
  - 7. Satin Stainless Steel: ANSI/BHMA 630.

- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

## 2.4 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Type I, waterproof type as selected by fabricator to comply with requirements.
  - 1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.5 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

### 3.2 INSTALLATION

- A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
  - 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
  - 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.
- E. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
  - 1. Inspection entity is to prepare and submit report of inspection.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116



## SECTION 071113 - BITUMINOUS DAMPPROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Cold-applied, emulsified-asphalt dampproofing.
- B. Related Sections include the following:
  - 1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders under slabs-on-grade.
  - 2. Division 071326 "Self-Adhering Sheet Waterproofing" for waterproofing.

#### 1.3 SUBMITTALS

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

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

#### 1.5 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

## PART 2 - PRODUCTS

### 2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Gardner Gibson, Inc.
  - 2. Henry Company.
  - 3. Karnak Corporation.
  - 4. Meadows, W. R., Inc.
- C. Trowel Coats: ASTM D 1227, Type II, Class 1.
- D. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
- E. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
- F. VOC Content: 0.25 lb/gal. or less.

### 2.2 MISCELLANEOUS MATERIALS

- A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
- B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- C. Patching Compound: Epoxy or latex-modified repair mortar of type recommended by dampproofing manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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



### 3.2 PREPARATION

- A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.
- C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections.

### 3.3 APPLICATION, GENERAL

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
  - 1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
  - 2. Allow each coat of dampproofing to cure 12 hours before applying subsequent coats.
  - 3. Allow 24 hours drying time prior to backfilling.
- B. Apply dampproofing to provide continuous plane of protection on exterior face of inner wythe of exterior masonry cavity walls at parking garage.
  - 1. Lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
  - 2. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe, and lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.

### 3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. On Exterior Face cast in place concrete or CMU: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft..

### 3.5 CLEANING

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

END OF SECTION 071113



## SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Sheet waterproofing.
  - 2. Blindside sheet waterproofing.- at elevator pit foundation

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
  - 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Shop Drawings: Provide shop drawings specific to this project that show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
  - 1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Sample Warranties: For special warranties.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

## 1.7 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
  - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

## 1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
  - 1. Warranty Period: Five years from date of Final Acceptance.
- B. Installer's Special Warranty: Specified form, signed by Installer, covering Work of this Section, for warranty period of two years.
  - 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Source Limitations for Waterproofing System: Obtain waterproofing system materials and accessories from single source from single manufacturer.

## 2.2 MODIFIED BITUMINOUS SHEET WATERPROOFING

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Grace Construction Products; Bituthene 3000/Low Temperature or comparable product by one of the following:
    - a. Carlisle Coatings & Waterproofing Inc.
    - b. Henry Company.
    - c. Meadows, W.R., Inc.
    - d. Polyguard Products, Inc.
  2. Physical Properties:
    - a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
    - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
    - c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
    - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
    - e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
    - f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
    - g. Water Vapor Permeance: 0.05 perms maximum; ASTM E 96/E 96M, Water Method.
    - h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.
  3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

## 2.3 BLINDSIDE SHEET WATERPROOFING

- A. Blindside Sheet Waterproofing for Horizontal Applications: Uniform, flexible, multilayered-composite sheet membrane that forms a permanent bond with fresh concrete placed against it; complete with accessories and preformed shapes for an unbroken waterproofing assembly; with the following physical properties:
1. Provide products by the same manufacturer as the Sheet Waterproofing product above.
  2. Physical Properties:
    - a. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D1970/D1970M.
    - b. Peel Adhesion to Concrete: 5 lbf/in. minimum; ASTM D903, modified.
    - c. Lap Adhesion: 5 lbf/in. minimum; ASTM D1876, modified.
    - d. Hydrostatic-Head Resistance: 230 feet; ASTM D5385, modified.
    - e. Puncture Resistance: 200 lbf minimum; ASTM E154/E154M.
    - f. Water Vapor Permeance: 0.1 perm maximum; ASTM E96/E96M, Water Method.
    - g. Ultimate Elongation: 335 percent minimum; ASTM D412, modified.

- B. Mastic, Adhesives, and Detail Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

## 2.4 AUXILIARY MATERIALS

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
  - 1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.

## 2.5 INSULATION

- A. Insulation, General: Comply with Section 072100 "Thermal Insulation."
- B. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, square edged.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company (The).
    - c. Owens Corning Insulating Systems LLC.
  - 2. Type IV, 25-psiminimum compressive strength.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.
  - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
  - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
- F. Bridge and cover isolation joint with overlapping sheet strips of widths according to manufacturer's written instructions.
  - 1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
  - 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
    - a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.

- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

### 3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch-minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.
  - 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.
- E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- F. Seal edges of sheet-waterproofing terminations with mastic.
- G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.
- H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- I. Immediately install protection course with butted joints over waterproofing membrane.

### 3.4 INSTALLATION OF BLINDSIDE SHEET WATERPROOFING

- A. Install blindside sheet waterproofing according to manufacturer's written instructions.
- B. Horizontal Applications: Install sheet with face against substrate. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by membrane manufacturer. Overlap and seal seams, and stagger and tape end laps to ensure watertight installation.
- C. Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.



- D. Seal penetrations through sheet waterproofing to provide watertight seal with detail tape patches or wraps and a liquid-membrane troweling.
- E. Install sheet waterproofing and accessory materials to produce a continuous watertight tie into adjacent waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 6 inches beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

### 3.5 INSULATION INSTALLATION

- A. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

### 3.6 FIELD QUALITY CONTROL

- A. Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components, and to furnish daily reports to Architect.

### 3.7 PROTECTION, REPAIR, AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071326



## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Extruded polystyrene foam-plastic board – slab insulation
2. Polyisocyanurate foam-plastic board. – building roof
3. Glass-fiber blanket.- roof rafter cavity
4. Mineral-wool blanket. –acoustic insulation
5. Mineral-wool board insulation- exterior wall insulation

- B. Related Requirements:

1. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
  1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
  2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
  3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

## PART 2 - PRODUCTS

### 2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.
- B. Extruded Polystyrene Board, Type VI for under slab insulation: ASTM C 578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. DiversiFoam Products.
    - b. Dow Chemical Company (The).
    - c. Owens Corning.

### 2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD

- A. Polyisocyanurate Board: ASTM C 1289, Type I, Class 1 or 2.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Hunter Panels "Cool Vent" Insulation (Basis of Design) or approved equal (Sloped Roof)
    - b. ACFoam® CrossVent
    - c. FlintBoard® CV
      - 1) 4" - R-14.4
      - 2) 3/4" deck
  - 2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly. Provide as part of a tested aluminum composite panel wall assembly.

### 2.3 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced, ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.

## 2.4 MINERAL-WOOL BLANKETS

- A. Mineral-Wool Blanket, Unfaced for use in UL details as required: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Industrial Insulation Group, LLC (IIG-LLC).
    - b. Roxul Inc.
    - c. Thermafiber, Inc.; an Owens Corning company.

## 2.5 MINERAL-WOOL BOARD INSULATION

- A. Mineral-Wool Board, for use in UL Fire Resistance details: Provide insulation board per ASTM C 612; with maximum flame-spread and smoke-developed per ASTM E 84; passing ASTM E 136 for combustion characteristics as required by UL Fire Resistance Details indicated.
- B. Mineral-Wool Board Insulation for use in exterior wall assemblies, Type IVB: ASTM C612, Type IVB; **unfaced**.
  1. Nominal Density: **8 lb/cu. ft.**
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ROCKWOOL. (Basis of Design)
    - b. Thermafiber, Inc.; an Owens Corning company.
    - c. Roxul Inc.

## 1.2 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  1. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

- B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.
  - 1. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## PART 2 - EXECUTION

### 2.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

### 2.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

### 2.3 INSTALLATION OF SLAB INSULATION

- A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.
- B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.
  - 1. If not otherwise indicated, extend insulation a minimum of 36 inches in from exterior walls.

## 2.4 INSTALLATION OF FOUNDATION WALL INSULATION

- A. Butt panels together for tight fit.
- B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application.
  - 2. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation.
  - 3. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.
- C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or dampproofing according to manufacturer's written instructions.

## 2.5 INSTALLATION OF CAVITY-WALL INSULATION

- A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
  - 1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

## 2.6 INSTALLATION OF CURTAIN-WALL INSULATION

- A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.
  - 1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
  - 2. Install insulation to fit snugly without bowing.

2.7 PROTECTION

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

2.8 INSULATION SCHEDULE

- A. Below Slab Insulation: XPS insulation
  - 1. Min. R-value: 15
  - 2. Thickness: 3 inches.
- B. Typical Exterior Siding Wall: Mineral Wool Board
  - 1. Min. R-Value: 7.6 continuous min.
  - 2. Thickness: 2 inches.
  - 3.
- C. Interior Partitions: Acoustic Batt Insulation (See Section 092900 "Gypsum Board")
  - 1. Install as indicated in the Partition Schedule.
- D. Roof Insulation:
  - 1. Cool Vent System and Polyisocyanurate Board Insulation
    - a. Min. R-Value: 25 C.I. minimum. – R29 C.I. shown on drawings
    - b. Thickness: 4.1 in cool vent at R14.4 C.I. + 3" Poly Iso at R15 C.I. = 7.1"

END OF SECTION 072100



## SECTION 072200 – VENTILATED NAILBASE INSULATION PANELS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Section includes ventilated nailbase insulation panel system.

#### 1.2 RELATED SECTIONS

- A. Section 061719 - Cross Laminated Timber.
- B. Section 061800 - Glued Laminated Construction.
- C. Section 061053 - Miscellaneous Rough Carpentry
- D. Section 72100 – Thermal Insulation.
- E. Section 074113 - Standing Seam Metal Roof.

#### 1.3 REFERENCES

- A. ASTM C 209 – Methods of Testing Insulating Board, Structural and Decorative.
- B. ASTM C 1289 – Specifications for Faced Rigid Cellular Polyisocyanurate Thermal Insulating Board.
- C. ASTM D 1621 – Test Methods for Compressive Properties of Rigid Cellular Plastics.
- D. ASTM D 2126 - Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- E. ASTM E 84 – Surface Burning Characteristics of Building Materials.
- F. ASTM E 96 - Test Method for Water Vapor Transmission of Materials.
- G. UL 1256 - Fire Test of Roof Deck Constructions.
- H. PS2-92 - Performance Standard for Wood-based Structural-use Panels.
- I. Miami Dade Product Control – Notice of Acceptance NOA No. 14-0505.08

#### 1.4 SYSTEM DESCRIPTION

A. Physical properties (Foam Core):

1. Manufactured using 3rd Generation Zero ODP, EPA Compliant Blowing Agent; Contains zero CFCs, HCFCs, or HFCs; Virtually no Global Warming Potential (GWP)
2. Compressive Strength: ASTM D 1621 and ASTM C 1289, Type V, Class 1, 20 psi (138 kPa) minimum for Grade 2 and 25 psi (172 kPa) minimum for Grade 3.
3. Also Available ASTM C 1289, Type V, Class 2, 20 psi (138 kPa) minimum for Grade 2 and 25 psi (172 kPa) minimum for Grade 3.
4. Dimensional Stability: ASTM D 2126, 2 percent linear change (7 days).
5. Moisture Vapor Transmission: ASTM E 96, < 1 perm ((57.5ng/(Pa•s•m2))).
6. Water Absorption: ASTM C 209, < 1 percent by volume.
7. Service Temperature: Minus 100 degrees to 250 degrees F (minus 73 degrees C to 122 degrees C).
8. Foam core flame spread index of 75 or less and smoke developed of 450 or less when tested in accordance with ASTM E 84.

B. Foam Core R Values: Based on LTTR (Long Term Thermal Resistance) in accordance with ASTM C 1289.

C. UL Assemblies: Insulated steel deck assemblies - UL 1256 (nos. 120, 123) TGDY. R20624 Shingle Deck Accessory; Cool-Vent roof insulation is classified for use with any Class A, B, or C asphalt glass mat or asphalt organic shingles, standing seam metal or tile roof coverings.

D. Hunter Panels Cool-Vent evaluated and listed under Miami Dade Product Control – Notice of Acceptance NOA No. 14-0505.08

#### 1.5 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Product Data: Manufacturer's data sheets on nailbase insulation panels and fasteners to be used, including:

1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Verification Samples: For each finish product specified, two samples, representing actual product.

1. Submit 6 by 6 inch (152 mm by 152 mm) samples of each board type required.
2. Submit samples of each fastener type required.

D. Manufacturer's Certificate: Certify ventilated nailbase insulation panels will conform to specified performance requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a company that regularly manufactures polyisocyanurate insulation panels and fully assembles ventilated nailbase insulation in-house with no outside fabrication.
- B. Manufacturer shall have multiple manufacturing facilities to ensure consistency of product supply.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Good construction practice dictates that all insulations should be protected from moisture and direct sunlight during job-site storage. Pallets of Hunter Panels Cool-Vent are protected by a 2-step packaging process using shrink wrap and a UV resistant polyethylene bag. This moisture resistant package is designed for protection from the elements during flatbed shipment from our facilities to the job-site.
- B. Store products in accordance with the manufacturer recommendations.
- C. Store product on a solid flat foundation and elevate a minimum of 2" above the finished surface.
- D. Slit the bundle packaging vertically down the center of the two short sides and cover with a waterproof tarpaulin
- E. Protect insulation from open flame and keep dry at all times.

1.8 PROJECT CONDITIONS

- A. Install only as much insulation as can be covered the same day by a completed roof covering material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Cool-Vent produced by Hunter Panels, 15 Franklin Street, Portland, Maine 04101. Phone: (207) 761-5678 or (888) 746-1114. Fax: (877) 775-1769. E-mail: [info@hpanels.com](mailto:info@hpanels.com). Web: [www.hunterpanels.com](http://www.hunterpanels.com).
- B. Substitutions: GAF ThermaCal2 or equivalent
- C. Requests for substitutions will be considered in accordance with provisions of Section 01600.

## 2.2 PANEL CONSTRUCTION

- A. Panels shall consist of a top layer of APA/TECO rated 5-ply CDX plywood, a middle layer of vented air space consisting of 1 inch (25.4 mm) thick wood spacers and a bottom layer of fiber-reinforced facers (GRF) polyisocyanurate foam insulation. Also available with coated glass facers (CGF) polyisocyanurate foam insulation.
1. Polyisocyanurate foam insulation shall conform to ASTM C 1289, Type V.
  2. Compressive Strength: 20 pounds per square inch (138 kPa) Grade 2.
  3. Compressive Strength: 25 pounds per square inch (172 kPa) Grade 3
  4. Multiple top layer substrate shall conform to PS2 and shall be as follows:
    - a. 5-ply CDX Plywood:
      - 1) Type:
        - a) Standard sheathing grade.
        - b) Fire-treated sheathing grade.
      - 2) Thickness:
        - a) 3/4 inch (19.1 mm).
- B. Vented airspace shall be a minimum of 1 inch (25 mm) in depth and provide not less than 92 percent overall free air movement through the panel. It shall have 55 percent or greater lateral free air movement. Panels shall be manufactured to provide cross directional ventilation without additional material being incorporated into the construction. Provide an airspace of:
1. 1.5 inch (38 mm) air space.
- C. Panel with wood nailable surface as specified shall be factory rabbetted 1/8 inch (3.2 mm) on all sides to prove for expansion of substrate.

## 2.3 PANEL TYPES

- A. Cool-Vent Panels: 4 feet by 8 feet (1220 mm by 2440 mm) with top layer surface of 3/4 inch (19.1 mm) 5-ply CDX plywood and a vented airspace of 1.5 inches (38 mm). Panel shall have an overall thickness, R-value, and flute spanability as follows:
1. Thickness 5.7 inches (145 mm), R Value 20.5, flute spanability 4-3/8 inches (111.13 mm).

## 2.4 PANEL FASTENERS

- A. Fasteners shall be FM Approved Hunter Panel SIP/SD Panel Fasteners for steel deck application. Fasteners have a 3/16 inch (5 mm) shank and are corrosion resistant with oversized heads. Length of fasteners shall be as recommended by Hunter Panels. Use of 2-inch (51 mm) round plates are not required. See the Hunter Panels application guide for instructions.
  - 1. Fasteners shall penetrate the top flute of steel deck a minimum of 1 inch (25 mm).
  - 2. Penetration of fastener into bottom flute is not acceptable.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until structural deck has been properly prepared.
- B. Verify deck, adjacent materials, and structural backing is dry and ready to receive insulation.
- C. Verify deck surface is flat, free of fins or protrusions and irregularities.
- D. If deck preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Apply vapor barrier and or retarder, as specified by the Architect or required by the local building code, to decking prior to the installation.
- B. Apply proper ridge and soffit vents to create an effective eave to ridge venting system in conjunction with Cool-Vent.

### 3.3 INSTALLATION

- A. Install panels with the wood (Plywood) side face up. Place panels in the manufacturers recommended pattern. Only factory assembled panels will be accepted. Fasten panels through the top nailable surface and also through the wood block panel spacers using Hunter Panels approved threaded fasteners.
- B. For multiple layered installations, install the base layer of panels loose-laid, and stagger the joints of subsequent layers in accordance with good roofing practice.
- C. For roof slopes up to 7/12 pitch, 7 inches (178 mm) rise in 12 inches (304 mm), the minimum number of fasteners shall be 18 per 4 foot by 8 foot (1220 mm by 2440 mm) panel.
- D. For roof slopes over 7/12 pitch, 7 inches (178 mm) rise in 12 inches (304 mm), the minimum number of fasteners shall be 24 per 4 foot by 8 foot (1220 mm by 2440 mm) panel.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Cover the top and edges of unfinished roof panel work to protect it from the weather and to prevent accumulation of water in the cores of the panels.
- C. Do not leave panels exposed to moisture. Wet panels shall be removed or allowed to completely dry prior to application of vapor barrier and/or roof covering.
- D. Apply only enough insulation panels per day that can be covered the same day by a completed roof covering material.

END OF SECTION 072200

## SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Vapor-permeable, fluid-applied air barriers.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For coatings, indicating VOC content.
2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

- C. Shop Drawings: For air-barrier assemblies.

1. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product certificates.

- B. Product test reports.

- C. Field quality-control reports.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

- B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as indicated on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
  - a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. VOC Content: 100 g/L or less.
- B. Low-Emitting Materials: Products shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

### 2.2 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.
- B. Air-Barrier Assembly Air Leakage: Maximum 0.0017 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

### 2.3 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

- A. High-Build, Vapor-Permeable Air Barrier: synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.
  1. Synthetic Polymer Type:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Momentive/GE Elemax 2600AWB, GE Ultraflash transition silicone sheeting.
      - 2) Pecora Corp XL, XL Flash System and XL Span transition sheeting.
      - 3) Tremco Incorporated; ExoAir 230 and ETA Transition silicone sheeting.



2. Physical and Performance Properties:

- a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
- b. Vapor Permeance: Minimum 15 perms; ASTM E 96/E 96M, Desiccant Method, Procedure A.
- c. Ultimate Elongation: Minimum 1000 percent; ASTM D 412, Die C.
- d. Adhesion to Substrate: Minimum 30 lbf/sq. in. when tested according to ASTM D 4541.
- e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly (not required with brick exterior skin).
- f. UV Resistance: Can be exposed to sunlight for 180 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

- A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials ***that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.***
- B. Liquid Flashing Material: Low modulus, single-component, non-sag, neutral-curing silicone sealant complying with ASTM 920 recommended by manufacturer for detailing joints, sealing gaps, and patching irregular surfaces.
- C. Precured Silicone Transition Strip: Manufacturers standard pre-cured, flexible, silicone extrusion with single-component, neutral curing, non-staining Class 25 silicone termination mastic/sealant for bonding transition strip to adjacent materials.
  1. Size: 50 ft. roll; 3-, 6- or 9-inch width.
  2. Color: Translucent.
- D. Termination Mastic/Sealant: ASTM C 920, Grade NS, Class 25, Use G, A, O (polyethylene); single-component, neutral curing silicone.
  1. Dynamic Movement: Plus or minus 25 percent per ASTM C 719.
- E. Joint Sealant: ASTM C 920, single-component, neutral curing silicone; Class 50, Grade NS, Use NT.

## PART 3 - EXECUTION

### 3.1 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.
- B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
- C. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- E. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.
- F. Bridge isolation joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

### 3.2 INSTALLATION

- A. Install materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

- D. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.
- E. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.
  - 1. Vapor-Permeable, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements.
- F. Do not cover air barrier until it has been tested and inspected by testing agency.
- G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### 3.3 FIELD QUALITY CONTROL

- A. Tests: As determined by testing agency from among the following tests:
  - 1. Air-barrier dry film thickness.
  - 2. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
  - 3. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783.
  - 4. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.
- B. Air barriers will be considered defective if they do not pass tests and inspections.
  - 1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
  - 2. Remove and replace deficient air-barrier components for retesting as specified above.
- C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- D. Prepare test and inspection reports.

### 3.4 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
- B. Remove masking materials after installation.

END OF SECTION 072726



## SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Standing-seam metal roof panels.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For standing-seam metal roof panels. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
  - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
- C. Samples: For each type of exposed finish required, prepared on Samples of size indicated below.
  - 1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For standing-seam metal roof panels, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof area and eave, including fascia, as shown on Drawings; approximately 48 inches square by full thickness, including attachments, underlayment, and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on metal panels during installation.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Two years from date of Final Acceptance.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Final Acceptance.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
  - 1. Warranty Period: 20 years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

1. Wind Loads: As indicated on Drawings: See Structural Drawings.
  2. Other Design Loads: As indicated on Drawings: See Structural Drawings.
  3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:
1. Test-Pressure Difference: 1.57 lbf/sq. ft.
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:
1. Test-Pressure Difference: 2.86 lbf/sq. ft.
- D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
1. Uplift Rating: UL 30.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 STANDING-SEAM METAL ROOF PANELS

- A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.
1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.

### 2.3 *VERTICAL-RIB, SEAMED-JOINT, STANDING-SEAM METAL ROOF PANELS*

- A. *Manufacturers: Subject to compliance with requirements, provide PAC-150 180° Double Lock Roofing Panels by PAC\_CLAD; Petersen Aluminum Corporation; a Carlisle company or an equivalent product by one of the following:*
1. *CENTRIA, a Nucor Brand.*



2. *Fabral, Inc.*
3. *MBCI: Cornerstone Building Brands.*
4. *Morin - A Kingspan Group Company.*

B. *Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.*

1. *Structural Support: Over solid deck.*
2. *Material: Metallic-coated steel.*
3. *Seam Type: Double folded.*
4. *Panel Profile: Flat pan.*
5. *Panel Coverage: 16 inches.*
6. *Panel Height: 1.5 inches.*
7. *Clips: Two piece, floating, designed to accommodate thermal movement.*

- a. *Steel Clips: 0.064-inch-nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.*
- b. *Clip Spacing: 24 inches.*

## 2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Carlisle WIP Products; a brand of Carlisle Construction materials.
  - b. Henry Company
  - c. Owens Corning.
  - d. Polyglass U.S.A., Inc.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

## 2.5 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

1. Nominal Thickness: 0.028 inch.
2. Surface: Smooth, flat finish.

## 2.6 MISCELLANEOUS MATERIALS

- A. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- B. 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. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- C. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
  2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

## 2.7 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

- C. 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. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- F. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

## 2.8 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. contrast.
- D. Steel Panels and Accessories:
  - 1. Metallic Fluoropolymer: Three-coat fluoropolymer finish with suspended metallic flakes containing not less than 70 percent PVDF resin by weight in both color coat and clear

topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

- a. Color: As Selected by architectural from full range of standard colors
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
  1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking, and that installation is within flatness tolerances required by metal roof panel manufacturer.
    - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

#### 3.3 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  1. Apply over the entire roof surface.
- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

- C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

### 3.4 INSTALLATION OF STANDING-SEAM METAL ROOF PANELS

- A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving metal panels.
  - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as metal panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  - 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  - 4. Watertight Installation:
    - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.

- b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
  - c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
  - 2. turer.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
  - 2. hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
  - 3. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

### 3.5 ERECTION TOLERANCES

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

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
- C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

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

END OF SECTION 074113.16





## SECTION 074646 - FIBER-CEMENT SIDING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Fiber-cement tongue and groove 5/8" siding.
2. Attachment Support Framing System - Z Girt Support System

B. Related Requirements:

1. Section 042000 "Unit Masonry"
2. Section 055000 – "Cold-Formed Metal Framing"
3. Section 061053 "Rough Carpentry".
4. Section 072100 "Thermal Insulation"
5. Section 072726 "Fluid Applied Membrane Air Barrier."
6. Section 099113 "Exterior Painting"

#### 1.2 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

A. Product Data:

1. Fiber-cement siding.

- B. Product Data Submittals: For each type of fiber-cement siding, Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- C. Samples for Initial Selection: For fiber-cement siding including related accessories.

- D. Samples for Verification: For each type, color, texture, and pattern required.

1. 12-inch-long-by-actual-width Sample of siding.

2. 24-inch-wide-by-36-inch-high Sample panel of siding assembled on plywood backing.
3. 12-inch-long-by-actual-width Samples of trim and accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of fiber-cement siding.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.
- C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.
- D. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of fiber-cement siding including related accessories, to include in maintenance manuals.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Furnish full lengths of fiber-cement siding including related accessories, in a quantity equal to 2 percent of amount installed.

#### 1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  1. Build mockup of typical wall area as shown on Drawings.
  2. Build mockups for fiber-cement siding including accessories.
    - a. Size: as shown on drawings.
    - b. Include outside corner on one end of mockup.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including cracking and deforming.
    - b. Deterioration of materials beyond normal weathering.
  - 2. Warranty Period: 30 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

- A. Fiber-Cement Siding: ASTM C1186, Type A, Grade II, fiber-cement board, noncombustible when tested in accordance with ASTM E136; with a flame-spread index of 25 or less when tested in accordance with ASTM E84.
  - 1. HardiePlank HZ10 tongue and groove “Aspyre” (Basis of Design)
  - 2. Nichiha
  - 3. American Fiber Cement
- B. Labeling: Provide fiber-cement siding that is tested and labeled in accordance with ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.
- C. Nominal Thickness: **Not less than 5/8 inch.**
- D. Horizontal Pattern: Boards 7 to 8-1/2 inches wide in plain style. (7” exposure)
  - 1. Texture: Smooth
- E. Profile: **Tongue and Groove or Ship Lap**

- F. Factory Priming: Manufacturer's standard acrylic primer.

## 2.3 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
  - 1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.
- B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:
  - 1. Mitered Corners.
  - 2. Door and window casings.
  - 3. Fasciae.
  - 4. Moldings and trim.
- C. Flashing: Provide stainless steel flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
- D. Fasteners:
  - 1. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
  - 2. For fastening fiber cement, use stainless steel fasteners.
  - 3. 1-5/8 inches (41 mm) No. 8-18 by 0.323 inch (8.2 mm) head self-drilling, ribbed buglehead screws.
- E. Insect Screening for Soffit Vents: Stainless steel, 18-by-18 mesh
- F. Continuous Soffit Vents: Aluminum, hat-channel shape, with perforations; 2 inches wide and not less than 96 inches long.
  - 1. Net-Free Area: 6 sq. in./linear ft
  - 2. Finish: Mill finish

## 2.4 FINISHES

- A. Factory Primer – Provide factory applied universal primer
  - 1. Primer: Factory primed by manufacturer
  - 2. Top Coat: Refer to Section 099113 Exterior Painting
- B. Provide accessories matching color and texture of adjacent siding unless

## 2.5 ATTACHMENT SUPPORT FRAMING SYSTEM

- A. Basis of Design Products: Subject to compliance with requirements, provide SMARTci Basic fiberglass reinforced GREENgirt composite framing support system by Advanced Architectural Products, Inc.
- B. System Performance: Constructed system must comply with ANSI ASHRAE 90.1-2007 definition for continuous insulation (c.i.).
- C. Wind Load Performance - Attachment system must show the following minimum results when tested in accordance with ASTM E330-02.
  - 1. 90 pound per square foot negative and positive pressure held for 60 seconds, system components shall not experience failure or gross permanent distortion.
  - 2. 135 pound per square foot negative and positive pressure held for 10 seconds, system components shall not experience failure or gross permanent distortion.
- D. Water penetration/ Air Leakage Performance - Attachment system substrate fasteners must show the following results when tested in accordance with ASTM E331-00 and ASTM E283-04.
  - 1. No water leakage seen on tested attachment system, specifically including substrate fasteners when tested up to 20 pounds per square foot pressure differential.
  - 2. Less than 0.01 cubic feet per minute per square foot air leakage through entire tested system at 1.6 and 6.2 pounds per square foot.
- E. Wind cycling (air pressure cycling) performance - Attachment system must show conformance to the following results when tested in accordance with ASTM EI886-05.
  - 1. A total of 4,500 air pressure cycles. Cycles must include 50 cycles at a maximum pressure of 90 pounds both positive and negative. Average cycle time must not be less than 3.25 seconds for both negative and positive cycles. No damage or deformation must be seen at end of test.
- F. Spacing to comply with applicable live and dead loads and any other requirements of the facade/panel and in accordance with the applicable building code, as indicated in the approved delegated design calculations.
- G. Galvanic Protection: Utilize tapes, gaskets and other methods as necessary to separate and prevent contact between dissimilar metals throughout.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
  - 1. Do not install damaged components.
  - 2. Install fasteners no more than 24 inches o.c.
- B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Formed wall sheet metal fabrications.
  - 2. Formed equipment support flashing.
  - 3. Formed overhead-piping safety pans.

- B. Related Requirements:

- 1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
  - 2. Division 04 for materials and installation of manufactured sheet metal through-wall flashing and trim integral with masonry.
  - 3. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings.
  - 4. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

#### 1.3 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.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

- 1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
  - 3. Review requirements for insurance and certificates if applicable.

4. Review sheet metal flashing observation and repair procedures after flashing installation.

## 1.5 ACTION SUBMITTALS

### A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

### B. Shop Drawings: Provide shop drawings specific to this project for sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
9. Include details of special conditions.
10. Include details of connections to adjoining work.
11. Detail formed flashing and trim at scale of not less than 3 inches per 12 inches.

### C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

### D. Calculations: Provide calculations to verify components meet ANSI-SPRI ESI.

## 1.6 INFORMATIONAL SUBMITTALS

### A. Qualification Data: For fabricator.

### B. Sample Warranty: For special warranty.

## 1.7 CLOSEOUT SUBMITTALS

### A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

### B. Special warranty.



## 1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical roof edge, including fascia, approximately 10 feet long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
  - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
  - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

## 1.10 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Final Acceptance.
- B. Installer's Warranty: Provide warranty for 2 years from time of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General: 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 SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. SPRI Wind Design Standard: Manufacture and install copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
  - 1. Design Pressure: As indicated on Drawings.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- E. Flashing installations shall not rely solely on sealants or gaskets for primary waterproofing performance.

### 2.2 SHEET METALS

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  - 1. Exposed Coil-Coated Finish:
    - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Color: To match adjacent metal panel.

3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
- C. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.
  1. Surface: Smooth, flat.
  2. Exposed Coil-Coated Finish:
    - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  3. Color: To match insulated metal panel.
  4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

## 2.3 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Carlisle Residential; a division of Carlisle Construction Materials.
    - b. Certainteed; SAINT-GOBAIN.
    - c. GCP Applied Technologies Inc.
    - d. Henry Company.
  2. Source Limitations: Obtain underlayment from single source from single manufacturer.
  3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.
- B. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

## 2.4 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  - 3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Solder:
  - 1. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead with maximum lead content of 0.2 percent.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- E. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- H. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

- I. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

## 2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
  1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
  1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
  2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions:
  1. Where lapped expansion joints cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams:
  1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.
- G. Do not use graphite pencils to mark metal surfaces.

## 2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

## 2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates.
1. Joint Style: Overlapped, 4 inches wide Butted with expansion space and 6-inch-wide, concealed backup plate.
  2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch-wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
  3. Fabricate from the following materials
    - a. As indicated on drawings: See roof plans and details for coping materials. Unless noted otherwise: Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, solder or weld watertight.
1. As indicated on drawings: See roof plans and details for coping materials. Coping Profile: As indicated on Drawings and in accordance with SMACNA's "Architectural Sheet Metal Manual."
  2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
  3. Fabricate from the following materials:
    - a. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.
- C. Base Flashing: Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.
- D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.
- E. Flashing Receivers: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

F. Roof-Penetration Flashing: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

## 2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

## 2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.040 inch thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

### 3.2 INSTALLATION OF UNDERLAYMENT

#### A. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

#### B. Install slip sheet, wrinkle free, over underlayment before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches.

### 3.3 INSTALLATION, GENERAL

#### A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder welds sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
6. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
7. Do not field cut sheet metal flashing and trim by torch.
8. Do not use graphite pencils to mark metal surfaces.

#### B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.



1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
  2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
    - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    - b. Form joints to completely conceal sealant.
    - c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
    - d. Adjust setting proportionately for installation at higher ambient temperatures.
      - 1) Do not install sealant-type joints at temperatures below 40 deg F.
  2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
  2. Do not solder metallic-coated steel and aluminum sheet.
  3. Do not use torches for soldering.
  4. Heat surfaces to receive solder, and flow solder into joint.
    - a. Fill joint completely.
    - b. Completely remove flux and spatter from exposed surfaces.
  5. Stainless Steel Soldering:

- a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
- b. Promptly remove acid-flux residue from metal after tinning and soldering.
- c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

### 3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Parapet Scuppers:
  1. 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. Anchor scupper closure trim flange to exterior wall and solder or seal with elastomeric sealant to scupper.

### 3.5 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.
  1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
  2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.
- B. Roof Edge Flashing:
  1. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- C. Copings:
  1. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
    - a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
    - b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

- E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.
  - 1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
  - 2. Extend counterflashing 4 inches over base flashing.
  - 3. Lap counterflashing joints minimum of 4 inches.
  - 4. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.
- F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

### 3.6 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

### 3.7 INSTALLATION OF MISCELLANEOUS FLASHING

- A. Equipment Support Flashing:
  - 1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
  - 2. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans:
  - 1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
  - 2. Pipe and install drain line to plumbing waste or drainage system.

### 3.8 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.9 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.10 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

## SECTION 077100 - ROOF SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Roof-edge drainage systems.
2. Reglets and counterflashings.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
3. Section 077253 "Snow Guards" for manufactured snow guard devices.
4. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.

3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

C. Samples: For each type of roof specialty and for each color and texture specified.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of roof specialty.
- C. Product Test Reports: For copings, for tests performed by a qualified testing agency.
- D. Sample Warranty: For manufacturer's special warranty.

### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For roofing specialties to include in maintenance manuals.

### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are SPRI ES-1 tested to specified design pressure.

### 1.6 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
  1. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 014000 "Quality Requirements"
  2. Build mockup of typical roof edge, including fascia, gutter and downspout, as indicated, including supporting construction, seams, attachments, underlayment, and accessories.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

## 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.
- B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

## 1.9 WARRANTY

- A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 074113.16 "Standing Seam Metal Roof Panels."
- B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 075419 "Polyvinyl-Chloride (PVC) Roofing."

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 2.3 REGLETS AND COUNTERFLASHINGS

A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Formed Aluminum: 0.050 inch thick.
2. Corners: Factory mitered and mechanically clinched and sealed watertight.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Formed Aluminum: 0.032 inch thick.

C. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

D. Aluminum Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

## 2.4 MATERIALS

A. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.



- B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by manufacturer for type of use and finish indicated, finished as follows:

## 2.5 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Carlisle Residential; a division of Carlisle Construction Materials.
    - b. Certainteed; SAINT-GOBAIN.
    - c. GCP Applied Technologies Inc.
    - d. Henry Company.
  - 2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F.
  - 3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F.
- B. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

## 2.6 MISCELLANEOUS MATERIALS

- A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
  - 1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
  - 2. Fasteners for Aluminum: Series 300 stainless steel.
- B. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

## 2.7 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Coil-Coated Aluminum Sheet Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- E. Aluminum Extrusion Finishes:
  - 1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF UNDERLAYMENT

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
  - 1. Apply continuously under copings and reglets and counterflashings.
  - 2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.
- B. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

### 3.3 INSTALLATION, GENERAL

- A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  - 4. Torch cutting of roof specialties is not permitted.
  - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
  - 1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  - 1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
  - 2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

- D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws .
- E. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

### 3.4 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

- A. Coordinate installation of reglets and counterflashings with installation of base flashings.
- B. Embedded Reglets: See Section 042000 "Unit Masonry" for installation of reglets.
- C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.
- D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

### 3.5 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

## SECTION 078413 - PENETRATION FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Penetrations in fire-resistance-rated walls.

- B. Related Sections:

- 1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

- C. Related Drawings:

- 1. See Sheet GI002 and GI003 for Code Data Summary outlining required fire resistance ratings and GI 103 UL Penetration Details.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.

- 1. 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.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
  - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
    - b. Classification markings on penetration firestopping correspond to designations listed by the following:
      - 1) UL in its "Fire Resistance Directory."
- C. Preinstallation Conference: Conduct conference at Project site.

## 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

## 1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Grace Construction Products.
  - 2. Hilti, Inc.
  - 3. Johns Manville.
  - 4. RectorSeal Corporation.
  - 5. Specified Technologies Inc.
  - 6. 3M Fire Protection Products.
  - 7. Tremco, Inc.; Tremco Fire Protection Systems Group.
  - 8. USG Corporation.

### 2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. Fire-resistance-rated walls include fire-barrier walls and fire partitions.
  - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-wool-fiber or rock-wool-fiber insulation.

- b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
  - c. Fire-rated form board.
  - d. Fillers for sealants.
- 2. Temporary forming materials.
  - 3. Substrate primers.
  - 4. Collars.
  - 5. Steel sleeves.

## 2.3 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:



1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

## 2.4 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
  1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
  2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
  3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing and inspecting agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Final Acceptance. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

END OF SECTION 078413



## SECTION 078443 - JOINT FIRESTOPPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Joints in or between fire-resistance-rated constructions.
  - 2. Joints in smoke barriers.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies and for wall identification.

- C. Related Drawings:

- 1. See Sheet GI002 for Code Data Summary outlining required fire resistance ratings and UL Joint Firestopping Detail.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

- 1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

## 1.6 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing joint firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its joint firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

## 1.9 COORDINATION

- A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of joints to accommodate joint firestopping systems.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
  - a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
    - 1) UL in its "Fire Resistance Directory."
    - 2) Intertek Group in its "Directory of Listed Building Products."

## 2.2 JOINT FIRESTOPPING SYSTEMS

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hilti, Inc.
    - b. 3M Fire Protection Products.
    - c. Nelson Firestop; a brand of Emerson Industrial Automation.
    - d. RectorSeal.
    - e. Roxul Inc.
    - f. Specified Technologies, Inc.
    - g. Thermafiber, Inc.; an Owens Corning company.
    - h. Tremco, Inc.
  2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
  - 1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
  - 2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

- A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.



3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### 3.4 IDENTIFICATION

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  2. Contractor's name, address, and phone number.
  3. Designation of applicable testing agency.
  4. Date of installation.
  5. Manufacturer's name.
  6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.
- B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.
- C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.
- B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Final Acceptance. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 078443



## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Nonstaining silicone joint sealants.
  - 2. Immersible joint sealants.
  - 3. Latex joint sealants.
- B. Related Requirements:
  - 1. NA

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
  - 1. Joint-sealant location and designation.
  - 2. Manufacturer and product name.
  - 3. Type of substrate material.
  - 4. Proposed test.
  - 5. Number of samples required.
- D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion-Test Reports: For each sealant application tested.
- G. Sample Warranties: For special warranties.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

## 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  - 1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  - 2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.

3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
  4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
  5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
  7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  2. Conduct field tests for each kind of sealant and joint substrate.
  3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

## 1.8 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Final Acceptance.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 20 years from date of Final Acceptance.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Low-Emitting Interior Sealants: Sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

### 2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Dow Corning Corporation; .
- b. GE Construction Sealants; Momentive Performance Materials Inc; SilPruf NB.
- c. Pecora Corporation; .
- d. Tremco Incorporated; .

## 2.3 IMMERSIBLE JOINT SEALANTS

- A. Immersible Joint Sealants. Suitable for immersion in liquids; ASTM C 1247, Class 1 or Class 2; tested in deionized water unless otherwise indicated
- B. Urethane, Immersible, S, P, 25, T, NT, I: Immersible, single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T, NT, and I.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Sika Corporation U.S.; Sikaflex 1c SL.
- b. Tremco Incorporated; Vulkem 45.
- c. W.R. Meadows, Inc; Pourthane SL.

## 2.4 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Bostik: Arkema
- b. Pecora Corporation
- c. Sika Corporation – Building Components.

## 2.5 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. BASF Construction Chemicals - Building Systems; Sonolac.
- b. Pecora Corporation; AC-20.
- c. Sherwin-Williams Company (The); .
- d. Tremco Incorporated; Tremflex 834.

## 2.6 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Construction Chemicals - Building Systems.
    - b. Construction Foam Products, a division of Nomaco, Inc.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Unglazed surfaces of ceramic tile.
    - d. Exterior insulation and finish systems.
  3. Remove laitance and form-release agents from concrete.
  4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
  - 4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
  - 5. Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
  - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
  - a. Whether sealants filled joint cavities and are free of voids.
  - b. Whether sealant dimensions and configurations comply with specified requirements.
  - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

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

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Final Acceptance. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
    - b. Joints between different materials listed above.
    - c. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, M, P, 50, T, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.
  - 1. Joint Locations:
    - a. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, immersible, S, P, 25, T, NT, I.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
  - 1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Control and expansion joints in unit masonry.
    - c. Joints between metal panels.
    - d. Joints between different materials listed above.
    - e. Perimeter joints between materials listed above and frames of doors, windows and louvers.
    - f. Control and expansion joints in ceilings and other overhead surfaces.
    - g. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Other joints as indicated on Drawings.
  - 2. Joint Sealant: Urethane, S, P, 25, T, NT.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Tile control and expansion joints.
    - c. Vertical joints on exposed surfaces of unit masonry and concrete walls and partitions.
    - d. Other joints as indicated on Drawings.
  2. Joint Sealant: Urethane, S, NS, 25, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
1. Joint Locations:
    - a. Control joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Acrylic latex.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- H. Joint-Sealant Application: Concealed mastics.
1. Joint Locations:
    - a. Aluminum thresholds.
    - b. Sill plates.
    - c. Other joints as indicated on Drawings.
  2. Joint Sealant: Butyl-rubber based.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Interior standard steel doors and frames.
- B. Related Requirements:
  - 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
2. Fabrication: Prepare Samples approximately 8 by 10 inches to demonstrate compliance with requirements for quality of materials and construction:
  - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
  - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

- D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  1. Provide additional protection to prevent damage to factory-finished units.



- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inchspace between each stacked door to permit air circulation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ceco Door; ASSA ABLOY.
  - 2. Curries Company; ASSA ABLOY.
  - 3. Steelcraft; an Allegion brand.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
  - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
  - 3. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.50 deg Btu/F x h x sq. ft.when tested according to ASTM C 518.

## 2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2; SDI A250.4, Level B. At all interior locations unless otherwise indicated in the Door and Frame Schedule.
  - 1. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
    - d. Edge Construction: Model 2, Seamless.
    - e. Edge Bevel: Bevel lock and hinge edges 1/8 inch in 2 inches.
    - f. Core: Manufacturer's standard.
    - g. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors.
  - 2. Frames:
    - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    - b. Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Full profile welded.
  - 3. Exposed Finish: Prime.

## 2.4 BORROWED LITES

- A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.
- B. Construction: Full profile welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

## 2.5 FRAME ANCHORS

- A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
  3. Post installed Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Material: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M; hot-dip galvanized according to ASTM A 153/A 153M, Class B.

## 2.6 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Glazing: Comply with requirements in Section 088000 "Glazing."

## 2.7 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding.

2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
  4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
  5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

## 2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.2 INSTALLATION

- A. General: Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with SDI A250.11.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
    - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    - b. Install frames with removable stops located on secure side of opening.
  - 2. Fire-Rated Openings: Install frames according to NFPA 80.
  - 3. Solidly pack mineral-fiber insulation inside frames.
  - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
  - 5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
  - 1. Non-Fire-Rated Steel Doors: Comply with SDI A250.8.
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
  - 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.3 CLEANING AND TOUCHUP

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

## SECTION 081216 – ALUMINUM DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Interior aluminum framing.
  - 2. Interior aluminum framing for acoustic assemblies.
  - 3. Full glazed aluminum framed doors.

- B. Related Requirements

- 1. Section 081416 "Flush Wood Doors" for wood doors installed in aluminum frames.
  - 2. Section 087100 "Door Hardware" for hardware to be installed on glazed aluminum doors and frames.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Sustainable Design Submittals:

- 1. Product Data: For sealants, indicating VOC content.
  - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.
  - 3. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.

4. Product Certificates: For materials manufactured within 100 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
  5. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
  6. Environmental Product Declaration: For each product.
  7. Health Product Declaration: For each product.
  8. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
  9. Third-Party Certifications: For each product.
  10. Third-Party Certified Life-Cycle Assessment: For each product.
- C. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Include full-size details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
    - a. Joinery.
    - b. Anchorage.
    - c. Glazing.
  2. Include point-to-point wiring diagrams showing the following:
    - a. Power requirements for each electrically operated door hardware.
    - b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
  - B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
  - C. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.
  - D. Source quality-control reports.



- E. Sample Warranties: For warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 1.8 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, and accessories, from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Deflection of Framing Members:
  - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

## 2.3 ALUMINUM FRAMING SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Old Castle 3000 or a comparable product by one of the following: Kawneer, Type II Frame System by Frameworks (an Assa Abloy company) or Omega Type II Framing System by Special-Lite, Inc.
  1. Wilson Partitions
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  1. Interior Framing Construction: Nonthermal.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Glazing Plane: Center.
  4. Finish: powder-coat.
  5. Fabrication Method: Field-fabricated stick system.
  6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  7. Steel Reinforcement: As required by manufacturer.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Acoustical Units: Provide double glazed 45 STC acoustical units where indicated.

## 2.4 ALUMINUM FRAMED DOORS

- A. Doors: See door schedule.
  1. Manufacturer's standard glazed entrance doors for manual-swing operation where indicated.
  2. Provide wide stile doors designed to accept full mortise locksets.
  3. Wood swing doors to be provided under Section 081416 "Flush Wood Doors."
- B. Acoustical Performance: 43 dB.

## 2.5 ENTRANCE DOOR HARDWARE

- A. General: Door hardware is to be provided under Section 087100 "Door Hardware."

## 2.6 GLAZING

- A. Privacy Glazing:

- 1. Fully Tempered (FT) Clear Glass: see Section 088000 "Glazing."
  - a. Thickness: As required for unit size but no less than 1/2 inch.
- 2. Color: Clear.
- 3. Glazing Sealants: As recommended by manufacturer.
- 4. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.7 MATERIALS

- A. Sheet and Plate: ASTM B 209 (ASTM B 209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
- C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
- D. Structural Profiles: ASTM B 308/B 308M.

## 2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

## 2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Entrance doors shall be internally reinforced at all hardware points and across framing joints with steel reinforcement.
- E. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.

C. Set continuous sill members and flashing in full sealant bed, as specified.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified.

G. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### 3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
  - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inchwide, limit offset from true alignment to 1/16 inch.
  - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inchwide, limit offset from true alignment to 1/8 inch.
  - c. Where surfaces are separated by reveal or protruding element of 1 inchwide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

END OF SECTION 084113



## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Solid-core five-ply flush doors with wood-veneer faces for transparent finish.
  - 2. Solid-core five-ply flush wood doors for opaque finish.
  - 3. Factory finishing flush wood doors.

- B. Related Requirements:

- 1. Section 081113 "Hollow Metal Doors and Frames" for hollow metal frames for flush wood doors.
  - 2. Section 081216 "Aluminum Frames" for aluminum frames for flush wood doors.
  - 3. Section 088000 "Glazing" for glass view panels in flush wood doors.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

- 1. Dimensions and locations of blocking.
  - 2. Dimensions and locations of mortises and holes for hardware.
  - 3. Dimensions and locations of cutouts.
  - 4. Undercuts.
  - 5. Requirements for veneer matching.
  - 6. Doors to be factory finished and finish requirements.
  - 7. Fire-protection ratings for fire-rated doors.

- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification:
  - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
  - 2. Corner sections of doors, approximately 8 by 10 inches (200 by 250 mm), with door faces and edges representing actual materials to be used.
    - a. Provide Samples for each species of veneer and solid lumber required.
    - b. Provide Samples for each color, texture, and pattern of plastic laminate required.
    - c. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is a certified participant in AWI's Quality Certification Program.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC-accredited certification body.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

#### 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.



- B. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

## 1.9 WARRANTY

- A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  3. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eggers Industries.
  2. Graham Wood Doors; an Assa Abloy Group company.
  3. Marshfield Door Systems, Inc.
  4. Mohawk Doors; a Masonite company.
  5. VT Industries, Inc.
- B. Source Limitations: Obtain flush wood doors indicated to be blueprint matched with paneling from single manufacturer.

### 2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
1. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

- B. WDMA I.S.1-A Performance Grade: Heavy Duty.
- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
  - 2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
  - 3. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
  - 4. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
  - 5. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- E. Mineral-Core Doors:
  - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
  - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
  - 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
    - a. Screw-Holding Capability: 550 lbper WDMA T.M.-10.

## 2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors with Opaque Finish:
  - 1. Grade: Premium, with Grade AA faces.
  - 2. Species: Maple.
  - 3. Cut: Rift cut.
  - 4. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
  - 5. Room Match: Paint door faces with same color as adjacent wall
  - 6. Exposed Vertical and Top Edges: Same species as faces - edge Type A.

7. Core: Structural composite lumber.
8. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
9. Construction: Seven plies, either bonded or nonbonded construction.
10. WDMA I.S.1-A Performance Grade: Heavy Duty.

B. Interior Doors, Solid-Core Five-Ply for Opaque Finish – See Door Schedule

1. ANSI/WDMA I.S. 1A Quality Grade: Premium.
2. Faces: MDO.
  - a. Apply MDO to standard-thickness, closed-grain, hardwood face veneers or directly to high-density hardboard crossbands.
3. Exposed Vertical and Top Edges: Any closed-grain hardwood.
  - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
  - b. Fire-Rated Pairs of Doors:
    - 1) Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
    - 2) Provide formed-steel edges and astragals with intumescent seals.
      - a) Finish steel edges and astragals with baked enamel same color as doors.
      - b) Finish steel edges and astragals to match door hardware (locksets or exit devices).

2.4 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
1. Wood Species: Same species as door faces.
  2. Profile: Flush rectangular beads.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

## 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
- C. Openings: Factory cut and trim openings through doors.
  - 1. Light Openings: Trim openings with moldings of material and profile indicated.
  - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

## 2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
- B. Factory finish doors.
- C. Transparent Finish:
  - 1. Grade: Premium.
  - 2. Finish: AWT's, AWMAC's, and WT's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
  - 3. Staining: As selected by Architect from manufacturer's full range.
  - 4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
  - 5. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
  - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
  - 1. Install fire-rated doors according to NFPA 80.
  - 2. Install smoke- and draft-control doors according to NFPA 105.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  - 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
    - a. Comply with NFPA 80 for fire-rated doors.
  - 2. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### 3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416



## SECTION 083113 - ACCESS DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

#### 1.3 ALLOWANCES

- A. Access doors and frames are part of an access door and frame allowance.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.
- C. Product Schedule: For access doors and frames. Use same designations indicated on Drawings.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection and temperature-rise limit ratings indicated, according to NFPA 252 or UL 10B.

#### 2.2 ACCESS DOORS AND FRAMES

- A. Recessed Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acudor Products, Inc.
  - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - c. MIFAB, Inc.
  - d. Nystrom, Inc.
2. Description: Door face recessed 5/8 inch for gypsum board infill; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: All locations.
4. Door Size: as indicated - coordinate with mechanical and electrical work.
5. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
6. Latch and Lock: Prepared for mortise cylinder.

## 2.3 FIRE-RATED ACCESS DOORS AND FRAMES

### A. Fire-Rated, Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acudor Products, Inc.
  - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
  - c. MIFAB, Inc.
  - d. Nystrom, Inc.
2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with concealed flange for gypsum board installation, self-closing door, and concealed hinge.
3. Locations: Wall.
4. Door Size: as indicated - coordinate with mechanical and electrical work.
5. Fire-Resistance Rating: Not less than that of adjacent construction.
6. Temperature-Rise Rating: 450 deg F at the end of 30 minutes.
7. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed.
8. Frame Material: Same material, thickness, and finish as door.
9. Latch and Lock: Self-closing, self-latching door hardware, prepared for mortise cylinder.

## 2.4 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.



- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

## 2.5 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
  - 1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.
  - 2. For concealed flanges with plaster bead for full-bed plaster applications, provide zinc-coated expanded-metal lath and exposed casing bead welded to perimeter of frames.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.
  - 1. For recessed doors with plaster infill, provide self-furring expanded-metal lath attached to door panel.
- E. Latch and Lock Hardware:
  - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
  - 2. Keys: Furnish two keys per lock and key all locks alike.
  - 3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."

## 2.6 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

- D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.

#### 3.3 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 RELATED SECTIONS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior storefront framing.
  - 2. Interior manual-swing entrance doors and door-frame units.
- B. Related Sections:
  - 1. Section 084413 " Glazed Aluminum Curtain Walls."

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Provide Type III EPDs from manufacturers that have third-party verified environmental impact data or comparable product data from another USGBC approved program or
- C. Industry-wide (generic) EPD (1/2 product credit) or
- D. Publicly available, critically reviewed life-cycle assessment conforming to ISO 14944 (1/4 product credit).
- E. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- F. Samples: For each exposed finish required.

- G. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.
- H. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer registered in the State of North Carolina responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.
- B. Product test reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

#### 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Final Acceptance.
- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 20 years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
  1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members: At design wind pressure, as follows:
  1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
  3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
    - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.
- E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:
  - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
2. Entrance Doors:
  - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
  - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 MANUFACTURERS

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

1. Oldcastle Building Envelope – FG 3000T (Basis of Design)
2. Kawneer North America.
3. YKK AP America Inc.

## 2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Thermally broken.
  - 2. Glazing System: Retained mechanically with gaskets on four sides or two sides with structural glazing as indicated on the drawings.
  - 3. Glazing Plane: Front.
  - 4. Finish: High-performance organic finish.
  - 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Materials:
  - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
    - a. Sheet and Plate: ASTM B 209.
    - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
    - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
    - d. Structural Profiles: ASTM B 308/B 308M.
  - 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
    - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
    - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
    - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

## 2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  - 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods. Provide internal steel reinforcement at all hardware attachment points and at framing joints.
  - 2. Door Design: Wide stile; 5-inch nominal width.

3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

## 2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
  1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
  2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
  3. Opening-Force Requirements:
    - a. Egress Doors: Not more than 15 lbfto release the latch and not more than 30 lbfto set the door in motion and not more than 15 lbfto open the door to its minimum required width.
    - b. Accessible Interior Doors: Not more than 5 lbfto fully open door.

## 2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.
- D. Sealants used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.



2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior and interior for vision glass.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Include internal water deflectors per manufacturer's installation instruction.
7. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
  - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

### 3.2 FIELD QUALITY CONTROL

- A. Testing Agency: a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
    - a. Perform a minimum of three tests in areas as directed by Architect.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

## SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Glazed aluminum curtain wall systems:
    - a. Conventionally glazed.

- B. Related Requirements:

- 1. Section 078443 "Joint Firestopping" perimeter fire-containment systems (safing insulation) field installed with glazed aluminum curtain walls.
  - 2. Section 079200 "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
  - 3. Section 088000 "Glazing" for curtain wall glazing.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

- 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

- a. Joinery, including concealed welds.
  - b. Anchorage.
  - c. Expansion provisions.
  - d. Glazing.
  - e. Flashing and drainage.
3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
- E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
  1. Joinery, including concealed welds.
  2. Anchorage.
  3. Expansion provisions.
  4. Glazing.
  5. Flashing and drainage.
- F. Delegated-Design Submittal: For glazed aluminum curtain walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
  1. For Installer.
  2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State of North Carolina.
- B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components from manufacturer.
  1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.
- C. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranties: For special warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.
- C. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of structural-sealant-glazed curtain wall assemblies.

## 1.8 WARRANTY

- A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals and other materials beyond normal weathering.
    - d. Water penetration through fixed glazing and framing areas.
    - e. Failure of operating components.
  - 2. Warranty Period: Five years from date of Final Acceptance.
- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
  - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: 20 years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazed aluminum curtain walls.
- B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  1. Glazed aluminum curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- C. Structural Loads:
  1. Wind Loads: As indicated on Drawings. Must comply with NCBC 1609.1.2.
  2. Other Design Loads: As indicated on Drawings.
- D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:
  1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans of greater than 13 feet 6 inches (4.1 m).
  2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
- E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).
- G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft. (480 Pa).
  2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters or water that is drained to exterior.
- H. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:
1. Thermal Transmittance (U-factor):
    - a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.29 Btu/sq. ft. x h x deg F (1.65 W/sq. m x K) as determined in accordance with NFRC 100.
  2. Solar Heat Gain Coefficient (SHGC):
    - a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.25 as determined in accordance with NFRC 200.
  3. Air Leakage:
    - a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa) when tested in accordance with ASTM E283.
  4. Condensation Resistance Factor (CRF):
    - a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined in accordance with AAMA 1503.
- I. Windborne-Debris Impact Resistance: Pass ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone 3 for basic protection. Must comply with NCBC 1609.1.2.

1. Large-Missile Test: For glazing located within 30 feet (9.1 m) of grade.
  2. Small-Missile Test: For glazing located between 30 feet (9.1 m) and 60 feet (18.2 m) above grade.
- J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
  2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.
    - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
    - b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
- K. Structural-Sealant Joints:
1. Designed to carry gravity loads of glazing.
- L. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
  2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

## 2.2 SOURCE LIMITATIONS

- A. Obtain all components of curtain-wall system and storefront system, including framing spandrel panels, entrances, sun control, and accessories, from single manufacturer.

## 2.3 GLAZED ALUMINUM CURTAIN WALL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kawneer North America, an Arconic company. – 1600 Wall System 1 with steel reinforcement
  2. Oldcastle Building Envelope.
  3. YKK AP America Inc.
- B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of



thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
  2. Glazing System: Retained mechanically with gaskets on four sides or Retained mechanically with gaskets on two sides and structural sealant on two sides.
  3. Glazing Plane: Front.
  4. Finish: Superior-performance organic finish.
  5. System: Stick system.
  6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  7. Steel Reinforcement: As required by manufacturer.
- C. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.
1. Include snap-on aluminum trim that conceals fasteners.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Entrance Door Systems: Comply with Section 084113 "Aluminum-Framed Entrances and Storefronts".

## 2.4 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: ASTM C509 or ASTM C864. Manufacturer's standard.
1. Color: Black.
- C. Glazing Sealants: As recommended by manufacturer.
- D. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.
1. Color: Match structural sealant.

## 2.5 OPERABLE UNITS

- A. Venting Windows.
1. Awning: Project out.
  2. Frames and Sashes: Aluminum extrusions complying with AAMA/ WDMA /CSA 101/IS.2/A440.
  3. Insulating-Glass Units: See Division 08 Section "Glazing".
  4. Projected Window Hardware:

- a. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets. Manufacturer's standard style and type.
  - b. Hinges: Non-friction type, not less than two per sash.
  - c. Lock: Lever handle and cam-action lock with keeper.
  - d. Limit Devices: Concealed support arms with adjustable, limited, hold-open limit devices designed to restrict sash opening. Limit clear opening to 6 inches for ventilation.
- 5. Insect Screens:
  - a. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
    - 1) Type and Location: Full, inside for project-out sashes.
  - b. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.
    - 1) Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
  - c. Glass-Fiber Mesh Fabric: 20-by-20 (0.85-by-0.85-mm) or 20-by-30 (0.85-by-0.42-mm) mesh of PVC-coated, glass-fiber threads; woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D 3656.
    - 1) Mesh Color: Manufacturer's standard.
- B. Doors: Comply with Division 08 Section "Aluminum-Framed Entrances and Storefronts"

## 2.6 MATERIALS

- A. Sheet and Plate: ASTM B209 (ASTM B209M).
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).
- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.7 SHADOWBOX

- A. Provide insulated shadowbox in locations as shown on the drawings.

1. Materials: Aluminum sheet minimum 22 ga.
2. See Section 072100 "Thermal Insulation" for mineral wool insulation, thickness as indicated on the drawings.
3. Provide ventilation and weeps as required by curtainwall manufacturer.

## 2.8 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  2. Reinforce members as required to receive fastener threads.
  3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.
- C. Concealed Flashing: Dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A240/A240M of type recommended by manufacturer.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil (0.762-mm) thickness per coat.

## 2.9 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from exterior.
  6. Provisions for safety railings mounted **between mullions at interior**.
  7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Fabricate components to resist water penetration as follows:
  - 1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- E. Curtain-Wall Framing: Fabricate components for assembly using shear-block system.
- F. Factory-Assembled Frame Units:
  - 1. Rigidly secure nonmovement joints.
  - 2. Prepare surfaces that are in contact with structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
  - 3. Seal joints watertight unless otherwise indicated.
  - 4. Install glazing to comply with requirements in Section 088000 "Glazing."
- G. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

## 2.10 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## 2.11 SOURCE QUALITY CONTROL

- A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions.
- B. Do not install damaged components.

- C. Fit joints to produce hairline joints free of burrs and distortion.
- D. Rigidly secure nonmovement joints.
- E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
- G. Seal joints watertight unless otherwise indicated.
- H. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- I. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
- J. Install components plumb and true in alignment with established lines and grades.

### 3.3 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

### 3.4 INSTALLATION OF STRUCTURAL GLAZING

- A. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- B. Set glazing into framing in accordance with sealant manufacturer's and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
- C. Set glazing with proper orientation, so that coatings face exterior or interior as specified.
- D. Hold glazing in place using temporary retainers of type and spacing recommended by manufacturer, until structural sealant joint has cured.
- E. Apply structural sealant to completely fill cavity, in accordance with sealant manufacturer's and framing manufacturer's written instructions and in compliance with local codes.
- F. Apply structural sealant at temperatures indicated by sealant manufacturer for type of sealant.
- G. Allow structural sealant to cure in accordance with manufacturer's recommendations.

- H. Clean and protect glass as indicated in Section 088000 "Glazing."

### 3.5 INSTALLATION OF WEATHERSEAL SEALANT

- A. After structural sealant has completely cured, remove temporary retainers and insert backer rod between lites of glass, as recommended by sealant manufacturer.
- B. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.

### 3.6 ERECTION TOLERANCES

- A. Install glazed aluminum curtain walls to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
  2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
  3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
    - c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
  4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls.
1. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. (0.45 L/s per sq. m) at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
    - a. Perform a minimum of three tests in areas as directed by Architect.
  2. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.
- C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

D. Prepare test and inspection reports.

END OF SECTION 084413





## SECTION 087100 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section includes:

1. Mechanical and electrified door hardware

##### B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

##### C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
  - a. "Metal Doors and Frames"
  - b. "Flush Wood Doors"
  - c. "Stile and Rail Wood Doors"
  - d. "Interior Aluminum Doors and Frames"
  - e. "Aluminum-Framed Entrances and Storefronts"
  - f. "Stainless Steel Doors and Frames"
  - g. "Special Function Doors"
  - h. "Entrances"

#### 1.02 REFERENCES

##### A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

##### B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule

2. Recommended Locations for Builders Hardware
  3. Keying Systems and Nomenclature
  4. Installation Guide for Doors and Hardware
- C. NFPA – National Fire Protection Association
1. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
  2. NFPA 101 – Life Safety Code
  3. NFPA 105 – Smoke and Draft Control Door Assemblies
  4. NFPA 252 – Fire Tests of Door Assemblies
- D. ANSI - American National Standards Institute
1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
  2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
  3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
  4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
  5. ANSI/SDI A250.8 - Standard Steel Doors and Frames
- 1.03 SUBMITTALS
- A. General:
1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
  2. Prior to forwarding submittal:
    - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
    - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
- B. Action Submittals:
1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
  2. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
    - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
  3. Door Hardware Schedule:
    - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.

- b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
  - c. Indicate complete designations of each item required for each opening, include:
    - 1) Door Index: door number, heading number, and Architect's hardware set number.
    - 2) Quantity, type, style, function, size, and finish of each hardware item.
    - 3) Name and manufacturer of each item.
    - 4) Fastenings and other pertinent information.
    - 5) Location of each hardware set cross-referenced to indications on Drawings.
    - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    - 7) Mounting locations for hardware.
    - 8) Door and frame sizes and materials.
    - 9) Degree of door swing and handing.
4. Key Schedule:
- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
  - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
  - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
  - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
  - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
  - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
- 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
  - 2. Provide Product Data:
    - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
- 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
    - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    - b. Catalog pages for each product.
    - c. Final approved hardware schedule edited to reflect conditions as installed.
    - d. Final keying schedule

- e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

E. Inspection and Testing:

- 1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
  - a. Fire door assemblies, in compliance with NFPA 80.
  - b. Required egress door assemblies, in compliance with NFPA 101.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

- 1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
- 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
- 3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
  - a. For door hardware: DHI certified AHC or DHC.
  - b. Can provide installation and technical data to Architect and other related subcontractors.
  - c. Can inspect and verify components are in working order upon completion of installation.
- 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

- 1. Fire-Rated Door Openings:
  - a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
  - b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.
- 2. Smoke and Draft Control Door Assemblies:

- a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
  - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
3. Accessibility Requirements:
- a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
  - a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
    - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
    - 2) Preliminary key system schematic diagram.
    - 3) Requirements for key control system.
    - 4) Address for delivery of keys.
2. Pre-installation Conference
  - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - b. Inspect and discuss preparatory work performed by other trades.
  - c. Review required testing, inspecting, and certifying procedures.
  - d. Review questions or concerns related to proper installation and adjustment of door hardware.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.
- F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

#### 1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

#### 1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
  - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
  - 2. Warranty Period: Beginning from date of Final Acceptance, for durations indicated in manufacturer's published listings.
    - a. Mechanical Warranty
      - 1) Locks
        - a) Schlage L Series: 3 years
      - 2) Exit Devices
        - a) Von Duprin: 3 years
      - 3) Closers
        - a) LCN 4050 Series: 25 years

#### 1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

## 2.02 MATERIALS

### A. Fabrication

- 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
  - 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
  - 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
- 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

## 2.03 HINGES

### A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product:
  - a. Ives 5BB series
- 2. Acceptable Manufacturers and Products:
  - a. McKinney TB series
  - b. Best FBB series

### B. Requirements:

- 1. Provide hinges conforming to ANSI/BHMA A156.1.
- 2. Provide five knuckle, ball bearing hinges.

3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
  - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
  - b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
  - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. 2 inches or thicker doors:
  - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
  - a. Steel Hinges: Steel pins
  - b. Non-Ferrous Hinges: Stainless steel pins
  - c. Out-Swinging Exterior Doors: Non-removable pins
  - d. Out-Swinging Interior Lockable Doors: Non-removable pins
  - e. Interior Non-lockable Doors: Non-rising pins

## 2.04 CONTINUOUS HINGES

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Select
  - b. Best

### B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.



## 2.05 INVISIBLE HINGE

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Soss
2. Acceptable Manufacturers:
  - a. Tectus
  - b. Sugatsune

### B. Requirements

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide steel-based hinges at fire rated openings.
3. Provide hinges completely mortised in door and jamb such that hinge is concealed when door is closed and allows 180 degrees opening.
4. Adjust hinge size and type for door dimensions, weight, and conditions.

## 2.06 FLUSH BOLTS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

### B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

## 2.07 MORTISE LOCKS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Schlage L9000 series
2. Acceptable Manufacturers and Products:
  - a. Accurate 9000/9100 series

b. Corbin-Russwin ML2000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
  - a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
  - b. Lever Design: 07.

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Von Duprin 98/35A series
2. Acceptable Manufacturers and Products:
  - a. Detex Advantex series
  - b. Precision APEX 2000 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.

6. Provide flush end caps for exit devices.
7. Provide exit devices with manufacturer's approved strikes.
8. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
9. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
10. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
12. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
13. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
15. Special Options:
  - a. HH
    - 1) Provide wind and impact rated hurricane exit devices and mullions certified to comply with Florida Building Code (FBC) TAS 201, 202, 203.
  - b. HW
    - 1) Provide wind rated hurricane exit devices and mullions certified to comply with ANSI-ASTM E330.

## 2.09 CYLINDERS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Schlage Everest 29 S
2. Acceptable Manufacturers and Products:
  - a. No Substitute

### B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
  - a. Patented Open: cylinder with interchangeable core with open keyway.
3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

## 2.10 KEYING

### A. Scheduled System:

1. New factory registered system:
  - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

### B. Requirements:

1. Construction Keying:
  - a. Replaceable Construction Cores.
    - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
      - a) 3 construction control keys
      - b) 12 construction change (day) keys.
    - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
2. Permanent Keying:
  - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
    - 1) Master Keying system as directed by the Owner.
  - b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
  - c. Provide keys with the following features:
    - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
  - d. Identification:
    - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    - 2) Identification stamping provisions must be approved by the Architect and Owner.
    - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
    - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
    - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
  - e. Quantity: Furnish in the following quantities.
    - 1) Permanent Control Keys: 3.
    - 2) Master Keys: 6.
    - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
    - 4) Key Blanks: Quantity as determined in the keying meeting.

## 2.11 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Telkee
2. Acceptable Manufacturers:
  - a. HPC
  - b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
  - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
  - b. Provide hinged-panel type cabinet for wall mounting.

## 2.12 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. LCN 4050A series
2. Acceptable Manufacturers and Products:
  - a. Norton 7500 series
  - b. Yale 4400 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

## 2.13 DOOR TRIM

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

### B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

## 2.14 PROTECTION PLATES

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

### B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Size plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

## 2.15 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturers:
  - a. Glynn-Johnson
2. Acceptable Manufacturers:
  - a. Rixson
  - b. ABH

### B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

## 2.16 DOOR STOPS AND HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

### B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

## 2.17 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Zero International
2. Acceptable Manufacturers:
  - a. National Guard
  - b. Reese

### B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

## 2.18 SILENCERS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

### B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

## 2.19 FINISHES

### A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Weatherstripping: Clear Anodized Aluminum
9. Thresholds: Mill Finish Aluminum

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION



- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
  - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
  - 1. Install construction cores to secure building and areas during construction period.
  - 2. Replace construction cores with permanent cores as indicated in keying section.
- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- K. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- L. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

- N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Final Acceptance, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

### 3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Final Acceptance.

### 3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

Hardware Group No. 01

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGES	BY DOOR MANUFACTURER		
1	EA	EXIT DEVICE	BY DOOR MANUFACTURER		
1	EA	RIM CYLINDER	20-057 EV D	626	SCH
1	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA	WEATHERSTRIP SEAL	BY DOOR MANUFACTURER		
1	EA	DOOR SWEEP	BY DOOR MANUFACTURER		
1	EA	THRESHOLD	BY DOOR MANUFACTURER		

1. THE HARDWARE SUPPLIER SHALL COORDINATE CYLINDER REQUIREMENTS WITH THE WIND IMPACT DOOR SUPPLIER'S HARDWARE & FURNISH THE TYPE REQUIRED.

2. THE HARDWARE SUPPLIER SHALL BE RESPONSIBLE TO INCLUDE ANY FASTENERS, BRACKETS, AND HARDWARE ACCESSORIES REQUIRED TO COMPLETE THE INTENDED APPLICATION.

3. THE WIND IMPACT DOOR SUPPLIER SHALL FURNISH THE HANGING HARDWARE, PANIC EXIT DEVICE HARDWARE, AND THE WEATHERSTRIPPING. SEE DOOR FUNCTION REQ'D.

4. DOOR FUNCTION: ENTRY BY KEY. PANIC HARDWARE: NL ACTIVE LEAF.

Hardware Group No. 02

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGES	BY DOOR MANUFACTURER		
2	EA	EXIT DEVICE	BY DOOR MANUFACTURER		
1	EA	RIM CYLINDER	20-057 EV D	626	SCH
2	EA	90 DEG OFFSET PULL	8190HD 10" O	630	IVE
2	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA	WEATHERSTRIP SEAL	BY DOOR MANUFACTURER		
2	EA	DOOR SWEEP	BY DOOR MANUFACTURER		
1	EA	THRESHOLD	BY DOOR MANUFACTURER		

1. THE HARDWARE SUPPLIER SHALL COORDINATE CYLINDER REQUIREMENTS WITH THE WIND IMPACT DOOR SUPPLIER'S HARDWARE & FURNISH THE TYPE REQUIRED.
2. THE HARDWARE SUPPLIER SHALL BE RESPONSIBLE TO INCLUDE ANY FASTENERS, BRACKETS, AND HARDWARE ACCESSORIES REQUIRED TO COMPLETE THE INTENDED APPLICATION.
3. THE WIND IMPACT DOOR SUPPLIER SHALL FURNISH THE HANGING HARDWARE, PANIC EXIT DEVICE HARDWARE, AND THE WEATHERSTRIPPING. SEE DOOR FUNCTION REQ'D.
4. DOOR FUNCTION: ENTRY BY KEY. PANIC HARDWARE: NL-OP ACTIVE LEAF WITH DOGGING, EO INACTIVE LEAF WITH DOGGING.

Hardware Group No. 03

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGES	BY DOOR MANUFACTURER		
1	EA	EXIT DEVICE	BY DOOR MANUFACTURER		
1	EA	RIM CYLINDER	20-057 EV D	626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10" O	630	IVE
1	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA	WEATHERSTRIP SEAL	BY DOOR MANUFACTURER		
1	EA	DOOR SWEEP	BY DOOR MANUFACTURER		
1	EA	THRESHOLD	BY DOOR MANUFACTURER		

1. THE HARDWARE SUPPLIER SHALL COORDINATE CYLINDER REQUIREMENTS WITH THE WIND IMPACT DOOR SUPPLIER'S HARDWARE & FURNISH THE TYPE REQUIRED.
2. THE HARDWARE SUPPLIER SHALL BE RESPONSIBLE TO INCLUDE ANY FASTENERS, BRACKETS, AND HARDWARE ACCESSORIES REQUIRED TO COMPLETE THE INTENDED APPLICATION.
3. THE WIND IMPACT DOOR SUPPLIER SHALL FURNISH THE HANGING HARDWARE, PANIC EXIT DEVICE HARDWARE, AND THE WEATHERSTRIPPING. SEE DOOR FUNCTION REQ'D.
4. DOOR FUNCTION: ENTRY BY KEY. PANIC HARDWARE: NL-OP ACTIVE LEAF WITH DOGGING.

Hardware Group No. 04

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGES	BY DOOR MANUFACTURER		
1	EA	DEADBOLT	BY DOOR MANUFACTURER		
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA	WEATHERSTRIP SEAL	BY DOOR MANUFACTURER		
1	EA	DOOR SWEEP	BY DOOR MANUFACTURER		
1	EA	THRESHOLD	BY DOOR MANUFACTURER		

1. THE HARDWARE SUPPLIER SHALL COORDINATE CYLINDER REQUIREMENTS WITH THE WIND IMPACT DOOR SUPPLIER'S HARDWARE & FURNISH THE TYPE REQUIRED.
2. THE HARDWARE SUPPLIER SHALL BE RESPONSIBLE TO INCLUDE ANY FASTENERS, BRACKETS, AND HARDWARE ACCESSORIES REQUIRED TO COMPLETE THE INTENDED APPLICATION.
3. THE WIND IMPACT DOOR SUPPLIER SHALL FURNISH THE HANGING HARDWARE, LOCKING HARDWARE, AND THE WEATHERSTRIPPING. SEE DOOR FUNCTION REQ'D.
4. DOOR FUNCTION: ENTRY BY KEY, PUSH PULL WHEN UNLOCKED.

Hardware Group No. 05

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 07A	626	SCH
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 06

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080R 07A	626	SCH
2	EA	OH STOP	90S	630	GLY
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 07

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070R 07A	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 08

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PANIC HARDWARE	98-L-NL-07	630	VON
1	EA	RIM CYLINDER	20-057 EV D	626	SCH
1	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 09

Provide each SGL door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
4	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080R 07A	626	SCH
1	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 10

Provide each SGL door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 07A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 11

Provide each PR door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
8	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	CLASSROOM LOCK	L9070R 07A	626	SCH
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CCV	630	IVE
2	EA	SILENCER	SR64	GRY	IVE



Hardware Group No. 12

Provide each SGL door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	FIRE EXIT HARDWARE	98-L-BE-F-07	630	VON
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

Hardware Group No. 13

Provide each SGL door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050R 07A L583-363	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 14

Provide each PR door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
6	EA	INVISIBLE HINGE	218	630	SOS
2	EA	FULL DUMMY TRIM	L0172 07A	626	SCH
2	EA	OH STOP	90S	630	GLY

Hardware Group No. 15

Provide each PR door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
8	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080R 07A	626	SCH
2	EA	WALL STOP	WS406/407CCV	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 16

Provide each SGL door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080R 07A	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 18

Provide each SGL door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080R 07A	626	SCH
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 19

Provide each SGL door(s) with the following:

QT Y		DESCRIPTION	CATALOG NUMBER	FINIS H	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070R 07A	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 20

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK	L9040 07A L583-363 L283-722	626	SCH
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 21

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGES	BY DOOR MANUFACTURER		
1	EA	STOREROOM LOCK	BY DOOR MANUFACTURER		
1	EA	SURFACE CLOSER	4050A SCUSH	689	LCN
1	EA	WEATHERSTRIP SEAL	BY DOOR MANUFACTURER		
1	EA	DOOR SWEEP	BY DOOR MANUFACTURER		
1	EA	THRESHOLD	BY DOOR MANUFACTURER		

1. THE HARDWARE SUPPLIER SHALL COORDINATE CYLINDER REQUIREMENTS WITH THE WIND IMPACT DOOR SUPPLIER'S HARDWARE & FURNISH THE TYPE REQUIRED.
2. THE HARDWARE SUPPLIER SHALL BE RESPONSIBLE TO INCLUDE ANY FASTENERS, BRACKETS, AND HARDWARE ACCESSORIES REQUIRED TO COMPLETE THE INTENDED APPLICATION.
3. THE WIND IMPACT DOOR SUPPLIER SHALL FURNISH THE HANGING HARDWARE, LOCKING HARDWARE, AND THE WEATHERSTRIPPING. SEE DOOR FUNCTION REQ'D.
4. DOOR FUNCTION: LOCKED AT ALL TIMES, ENTRY BY KEY.

END OF SECTION 087100



## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Glass for doors, interior borrowed lites, storefront framing, and glazed curtain walls.
  - 2. Glazing sealants and accessories.
- B. Related Requirements:
  - 1. Section 081216 "Aluminum Doors and Frames."
  - 2. Section 084113 "Aluminum-Framed Entrances and Storefronts."
  - 3. Section 084423 "Glazed Aluminum Curtain Wall"
  - 4. Section 088300 "Mirrors."

#### 1.3 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Provide Type III EPDs from manufacturers that have third-party verified environmental impact data or comparable product data from another USGBC approved program or
- C. Industry-wide (generic) EPD (1/2 product credit) or
- D. Publicly available, critically reviewed life-cycle assessment conforming to ISO 14944 (1/4 product credit).
- E. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

- F. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- G. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer registered in the Commonwealth of Virginia responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.

#### 1.6 QUALITY ASSURANCE

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

#### 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

#### 1.8 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Final Acceptance.
- B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
  - 1. Warranty Period: 10 years from date of Final Acceptance.

- C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
1. Warranty Period: 10 years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:
1. Guardian Industries Corp.; SunGuard 62/27. (Basis of Design)
  2. Viracon, Inc VNE 35/63.
  3. Vitro Solarban 70.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
  2. Design Snow Loads: As indicated on Drawings.
  3. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.
- F. The project is in a wind-borne debris region and therefore must comply with NCBC 1609.1.2.

## 2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- B. Ceramic-Coated Spandrel Glass: ASTM C 1048, Type I, Condition B, Quality-Q3.

## 2.5 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
  - 1. Sealing System: Dual seals.
  - 2. Perimeter Spacer: Manufacturer's standard spacer material and construction.



## 2.6 GLAZING SEALANTS

### A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealant shall have a VOC content of 250 g/L or less.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range. To match color of mullions: to be Dark Charcoal for all dark gray mullions and light gray for light gray mullions

## 2.7 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

## PART 3 - EXECUTION

### 3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

### 3.6 MONOLITHIC GLASS SCHEDULE

- A. Glass Type GL-1: Clear fully tempered float glass for interior storefront.

1. Minimum Thickness: 9 mm (minimum)-19 mm based on span.
2. Safety glazing required.

### 3.7 INSULATING GLASS SCHEDULE

#### A. Glass Type IGU-1: Low-E-coated, clear insulating glass (Typical Curtain Wall Vision Glass)

1. Basis-of-Design Product: Guardian Glass SNX62/27.
2. Overall Unit Thickness: 1 5/16 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: 1/4" Guardian Sunguard SNX 62/27 on Ultra Clear Low-E #2 Fully tempered float glass.
5. Interspace Content: 1/2" Black Energy Spacer (90% Argon fill)
6. Indoor Lite: 9/16" Laminate – 1/4" Guardian UltraClear Fully tempered float glass, 0.060" PVB, 1/4" Guardian ultraclear, fully tempered float glass.
7. Low-E Coating: Pyrolytic or sputtered on second surface.
8. Winter Nighttime U-Factor: 0.23 maximum.
9. Summer Daytime U-Factor: 0.21 maximum.
10. Visible Light Transmittance: 64% percent minimum.
11. Solar Heat Gain Coefficient: 0.29 maximum.
12. Ultraviolet Transmittance <1%
13. Safety glazing required.
14. The project is in a wind-borne debris region and therefore must comply with NCBC 1609.1.2.

#### B. Glass Type IGU-2: low-E, insulating glass with shadow box back pan.

1. Basis-of-Design Product: Same glazing product as IGU-1
2. Overall Unit Thickness: 1 5/16" inch.
3. The project is in a wind-borne debris region and therefore must comply with NCBC 1609.1.2.

#### C. Glass Type IGU-3: Low-E-coated, clear insulating glass (Storefront and Curtain Wall Doors w/ Vision Glass)

1. Basis-of-Design Product: Guardian Glass SNX62/27
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: 1/4" Guardian Sunguard SNX 62/27 on Ultra Clear Low-E #2 Fully tempered float glass.
5. Interspace Content: 1/2" Black Energy Spacer (90% argon fill)
6. Indoor Lite: 5/16" Laminate – 1/8" Guardian UltraClear Fully tempered float glass, 0.060" PVB, 1/8" Guardian Ultraclear, fully tempered float glass.
7. Low-E Coating: Pyrolytic or sputtered on second surface.
8. Winter Nighttime U-Factor: 0.23 maximum.
9. Summer Daytime U-Factor: 0.21 maximum.
10. Visible Light Transmittance: 64% percent minimum.
11. Solar Heat Gain Coefficient: 0.29 maximum.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

12. Ultraviolet Transmittance <1%
13. Safety glazing required.
14. The project is in a wind-borne debris region and therefore must comply with NCBC 1609.1.2.

END OF SECTION 088000

## SECTION 088300 - MIRRORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes the following types of silvered flat glass mirrors:
  - 1. Film-backed glass mirrors qualifying as safety glazing.
- B. Related Requirements:
  - 1. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
  - 2. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.
- C. Samples: For each type of the following:
  - 1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
  - 2. Mirror Clips: Full size.
  - 3. Mirror Trim: 12 inches long.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of mirror and mirror mastic.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.
  - 1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
  - 1. Warranty Period: Five years from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

### 2.2 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
  - 1. Adhesive shall have a VOC content of 70 g/L or less.
- D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

### 2.3 MIRROR HARDWARE

- A. Aluminum J-Channels and Cleat: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
  - 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
  - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
  - 3. Finish: Clear bright anodized.
- B. Plated Steel Hardware: Formed-steel shapes with plated finish indicated.
- C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- D. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.



## 2.4 FABRICATION

- A. Fabricate mirrors in the shop to greatest extent possible.
- B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.
- C. Mirror Edge Treatment: Flat polished.
  - 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
  - 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.
- D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

### 3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

### 3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
  - 1. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

- B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
  - 1. Aluminum J-Channels and Cleat: Fasten J-channel directly to wall and attach top trim to continuous cleat fastened directly to wall.
  - 2. Install mastic as follows:
    - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
    - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
    - c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

### 3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Final Acceptance. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300



## SECTION 089119 - FIXED LOUVERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fixed louvers.
  - 2. Blank-off panels for louvers

#### 1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axis of the blades are vertical).
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing according to AMCA 500-L.
- F. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing according to AMCA 540.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer from the state of North Carolina responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Sample Warranties: For manufacturer's special warranties.

#### 1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M.
2. AWS D1.3/D1.3M.
3. AWS D1.6/D1.6M.

#### 1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

#### 1.8 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
  - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
  - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Warranty Period: 20 years from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer registered in the state of North Carolina, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- C. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

### 2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Wind-Driven-Rain-Resistant Louver:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties Group, C/S Louvers RS-7315 or comparable product by one of the following:
    - a. Greenheck Fan Corporation.
    - b. Industrial Louvers Inc.
    - c. United Enertech Corporation.
  - 2. Louver Depth: 7 inches.

3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
4. Louver Performance Ratings:
  - a. Free Area: Refer to mechanical louver schedule.
  - b. Air Performance: Not more than 0.394-inch wg static pressure drop at 900-fpm free-area exhaust velocity.
  - c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 mph at a core-area intake velocity of 500 fpm.
5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

## 2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
  1. Screen Location for Fixed Louvers: Interior face.
  2. Screening Type: Bird screening.
- B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
  1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
  2. Finish: Same finish as louver frames to which louver screens are attached.
  3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:
  1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

## 2.5 BLANK-OFF PANELS

- A. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
  1. Thickness: 2 inches.
  2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
  3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
  4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard channel frames, with corners mitered and with same finish as panels.
  5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
  6. Panel Finish: Same type of finish applied to louvers, but black color.
  7. Attach blank-off panels with sheet metal screws.

## 2.6 MATERIALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.
- B. Fasteners: Use types and sizes to suit unit installation conditions.
  - 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
  - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
  - 3. For color-finished louvers, use fasteners with heads that match color of louvers.
- C. Post installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E 488/E 488M conducted by a qualified testing agency.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
- E. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.
- F. Regional Materials: Products shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

## 2.7 FABRICATION

- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
  - 1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
  - 2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.



1. Frame Type: Channel unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.
- G. Provide subsills made of same material as louvers for recessed louvers.
- H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

## 2.8 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. High-Performance Organic Finish: -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  1. Color and Gloss: As selected by Architect from manufacturer's full range. To match adjacent wall color.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

### 3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

### 3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119



## SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes gypsum board shaft wall assemblies.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and support them on risers on a flat platform to prevent sagging.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.
- B. Do not install finish panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Regional Materials: Products shall be manufactured within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

### 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: 1 hours.
- B. STC Rating: As indicated.
- C. Gypsum Shaftliner Board:
  - 1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Georgia-Pacific Building Products; ToughRock Fireguard Shaftliner.
      - 2) National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
      - 3) United States Gypsum Company; Sheetrock Brand Gypsum Liner Panel.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
  - 1. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
  - 1. Depth: 3-5/8 inches.
  - 2. Minimum Base-Metal Thickness: 0.033 inch.

- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
    - 1. Minimum Base-Metal Thickness: Matching steel studs.
  - G. Elevator-Hoistway-Entrance Struts: Manufacturer's standard J-profile jamb strut with long-leg length of 3 inches, matching studs in depth, and not less than 0.033 inch thick.
  - H. Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board."
- 2.3 Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board." AUXILIARY MATERIALS
- A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.
  - B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
  - C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  - D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
    - 1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
    - 2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
  - E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).
  - F. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."
  - G. Gypsum Board Cants:
    - 1. Gypsum Board Panels: As specified in Section 092900 "Gypsum Board," Type X, 1/2- or 5/8-inch panels.
    - 2. Adhesive: Laminating adhesive as specified in Section 092900 "Gypsum Board."
    - 3. Non-Load-Bearing Steel Framing: As specified in Section 092216 "Non-Structural Metal Framing."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."
- B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

#### 3.3 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
  - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
  - 2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.
- D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

- E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- F. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- G. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- H. Gypsum Board Cants: At projections into shaft of 4 inches or more, install gypsum board cants covering tops of projections.
  - 1. Slope cant panels at least 75 degrees from horizontal. Set base edge of panels in adhesive and secure top edges to shaft walls at 24 inches o.c. with screws fastened to shaft wall framing.
  - 2. Where non-load-bearing steel framing is required to support gypsum board cants, install framing at 24 inches o.c. and extend studs from the projection to shaft wall framing.
- I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.4 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and 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 092116.23





## SECTION 092216 - NON-STRUCTURAL METAL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior partitions.
  - 2. Suspension systems for interior ceilings and soffits.
  - 3. Grid suspension systems for gypsum board ceilings.
- B. Single Source: To the extent possible, provide all framing components from the same manufacturer.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed steel studs and tracks, firestop tracks, post-installed anchors, and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

#### 1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to a minimum of 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. unless noted otherwise. Limit deflection of wall assemblies for ceramic tile to a deflection of 1/360.

### 2.2 FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G60, hot-dip galvanized unless otherwise indicated.
- C. Studs and Tracks: ASTM C 645. Use either steel studs and tracks or embossed steel studs and tracks.
  - 1. Steel Studs and Tracks:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) CEMCO; California Expanded Metal Products Co.
      - 2) ClarkDietrich Building Systems.
      - 3) MarinoWARE.
    - b. Minimum Base-Metal Thickness: 0.0269 inch.
    - c. Depth: As indicated on Drawings.
  - 2. Embossed Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally equivalent to conventional ASTM C 645 steel studs and tracks.

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1) CEMCO; California Expanded Metal Products Co.
  - 2) ClarkDietrich Building Systems.
  - 3) MarinoWARE.
- D. Slip-Type Head Joints: Where indicated, provide one of the following:
  - 1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing minimum vertical movement.
  - 2. Single Long-Leg Track System: ASTM C 645 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  - 3. Double-Track System: ASTM C 645 top outer tracks, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
  - 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Metal Thickness: 0.0329 inch.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
  - 1. Depth: 1-1/2 inches.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: 0.0296 inch.
  - 2. Depth: 7/8 inch.
- I. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
  - 1. Configuration: Asymmetrical.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
  - 1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES as appropriate for the substrate.
    - a. Uses: Securing hangers to structure.
    - b. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch- wide flanges.
  - 1. Depth: 2-1/2 inches.
- E. Furring Channels (Furring Members):
  - 1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.
    - a. Minimum Base-Metal Thickness: 0.0296 inch.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc; Drywall Grid Systems.
    - b. Chicago Metallic Corporation; .
    - c. United States Gypsum Company; .

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
  - 1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
  - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

#### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
  - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
  - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: unless otherwise indicated.
  - 2. Multilayer Application: unless otherwise indicated.
  - 3. Tile Backing Panels: unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

- 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Hangers: o.c.
  - 2. Carrying Channels (Main Runners): o.c.
  - 3. Furring Channels (Furring Members): o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 4. Do not attach hangers to steel roof deck.
  - 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 7. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.



- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Interior gypsum board.
  - 2. Exterior gypsum board for ceilings and soffits.
  - 3. Tile backing panels.
- B. Single Source: To the extent possible, provide all gypsum board products from the same manufacturer.
- C. Related Requirements:
  - 1. Section 079219 "Acoustical Joint Sealants" for sealant types and installation in walls with required STC ratings.
  - 2. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
  - 3. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
  - 4. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

#### 1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Ceiling and wall materials shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

#### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Georgia-Pacific Building Products.
    - b. National Gypsum Company.

- c. USG Corporation.

## 2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 1. Thickness: 5/8 inch.
  - 2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
- B. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
  - 1. Thickness: 1/2 inch.
  - 2. Long Edges: Tapered.

## 2.4 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
  - 1. Core: 1/2 inch, regular type.

## 2.5 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.
  - 1. Core: 1/2 inch, regular type.
  - 2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.6 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
  - 2. Shapes:
    - a. Cornerbead.
    - b. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - c. Expansion (control) joint.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Fry Reglet Corporation.
  - b. Gordon, Inc.
  - c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
  3. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## 2.7 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
  2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  3. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.
- D. Joint Compound for Exterior Applications:
  1. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.
- E. Joint Compound for Tile Backing Panels:
  1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

## 2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inchthick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  - 2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less 25 percent.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft.in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
  - 1. See the partition schedule for partitions with required STC ratings.
  - 2. See Section 079219 for application of acoustical joint sealants.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: As indicated on Drawings.
  - 2. Ceiling Type: Ceiling surfaces.
  - 3. Abuse-Resistant Type; Corridor 111 and Corridor 210
- B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
  - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
  2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers and locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.



### 3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  - 1. Cornerbead: Use at outside corners unless otherwise indicated.
  - 2. U-Bead: Use at exposed panel edges.
- D. Aluminum Trim: Install in locations indicated on Drawings.

### 3.7 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile.
  - 3. Level 3: Panel surfaces in back-of-house spaces such as mechanical, plumbing rooms, telecom rooms
  - 4. Level 4: At all surfaces exposed to view in hallways, classroom, kitchen, office area and conference rooms.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
  - 5. Level 5: NA
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.8 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900



## SECTION 093013 - CERAMIC TILING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Thresholds.
3. Waterproof membranes.
4. Crack isolation membranes.
5. Setting material.
6. Grout materials.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing of movement joints in tile surfaces.
2. Section 092900 "Gypsum Board" for tile backing panels.

#### 1.2 DEFINITIONS

- A. General: Definitions in ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. Face Size: Actual tile size, excluding spacer lugs.
- C. Large Format Tile: Tile with at least one edge 15 inches or longer.
- D. Module Size: Actual tile size plus joint width indicated.

#### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

- B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces for architect's review and approval. Show thresholds.

- C. Samples for Initial Selection: For tile, grout, and accessories involving color selection or shade variation.
- D. Samples for Verification:
  - 1. Full-size units of each type and composition of tile and for each color and finish required.
  - 2. Full-size units of each type of trim and accessory for each color and finish required.
  - 3. Stone thresholds in 6-inch lengths.
  - 4. Metal flooring transitions 6-inch lengths.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- C. Product Certificates: For each type of product, including product use classification.
- D. Product Test Reports:
  - 1. Tile-setting and -grouting products.
  - 2. Certified porcelain tile.
  - 3. Slip-resistance test reports from qualified independent testing agency.
- E. Field Quality-Control Reports: Water test reports of membrane in wet areas.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
  - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

2. Installer's supervisor for Project holds the International Masonry Institute's Supervisor Certification.
3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.
4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of membranes, shower receptors, and large format tile.
5. Provide documentation for review of any company, supervisor, and installer qualifications and certifications as described in the current TCNA handbook section "Installer and Contractor Qualifications Guide."

#### 1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  1. Build mockup of each type of floor tile installation.
  2. Build mockup of each type of wall tile installation.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and installation materials on elevated platforms, under cover, and in a dry location.
- C. Store liquid materials in unopened containers and protected from freezing.

#### 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

#### 1.11 WARRANTY

- A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.
  1. Warranty Period: 18 months from date of Product Purchase.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Tile: Obtain tile of each type and color or finish from single source or producer.
  - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Tiling System: Obtain system products from single manufacturer and each aggregate from single source or producer.
  - 1. Obtain setting and grouting materials, except for unmodified portland cement and aggregate, from single manufacturer.
  - 2. Obtain underlayment from manufacturer of setting and grouting materials.
  - 3. Obtain waterproof membrane, crack isolation, and other required membranes from manufacturer of setting and grouting materials.
  - 4. Obtain joint sealants from manufacturer of setting and grouting materials.
- C. Accessory Products: Obtain each of the following products specified in this Section from a single manufacturer:
  - 1. Stone thresholds.

### 2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard Grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
  - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

## 2.3 PORCELAIN TILE

### A. Porcelain Tile Type CT1, CT2, CTB1: Glazed.

1. Basis of Design product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
  - a. Crossville.
  - b. Florida Tile.
  - c. Daltile.
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: As indicated on drawings.
4. Face Size Variation: Rectified.
5. Thickness: 9.0 mm.
6. Product Use Classification: Interior, Wet Plus (IW+).
7. Tile Color, Glaze, and Pattern: As indicated on drawings.
8. Grout Color: As indicated on drawings.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
  - a. Base: Surface bullnose, module size as indicated on drawings.

### B. Porcelain Tile Type CT3: Glazed.

1. Basis of Design product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
  - a. Mondani
  - b. Architessa
  - c. Daltile.
2. Face Size: As indicated on drawings.
3. Thickness: 7.4 mm.
4. Tile Color, Glaze, and Pattern: As indicated on drawings.
5. Grout Color: As indicated on drawings.

## 2.4 THRESHOLDS

- ### A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.



- B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 12 in accordance with ASTM C1353/C1353M or ASTM C241/C241M and with honed finish.

1. Description:

- a. Uniform, fine- to medium-grained white stone with gray veining.

2.5 WATERPROOF MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Products: Subject to compliance with requirements, provide one of the following:

1. Waterproof Membrane, Sheet: Polyethylene sheet faced on one or both sides with polyester fabric.

- a. Basis of design product: Schluter Systems; KERDI  
b. Nominal Thickness: 8 mil.

2. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer.

- a. Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.  
b. Laticrete International, Inc.; Laticrete Hydro Ban  
c. TEC; H. B. Fuller Construction Products Inc.; HydraFlex-Waterproofing Crack Isolation Membrane.  
d. Mapei; Mapelastic HPG.

2.6 CRACK ISOLATION MEMBRANES

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Products: Subject to compliance with requirements, provide one of the following:

1. Polyethylene Sheet: Polyethylene faced on both sides with polyester fabric.

- a. Basis of design product: Schluter Systems; KERDI

2. Fluid Applied: Liquid-latex rubber or elastomeric polymer.

- a. Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.  
b. Laticrete International, Inc.; Laticrete Hydro Ban

- c. TEC; H. B. Fuller Construction Products Inc.; HydraFlex-Waterproofing Crack Isolation Membrane.
- d. Mapei; Mapelastic HPG.

## 2.7 SETTING MATERIALS

### A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Custom Building Products
  - b. Laticrete International, Inc.
  - c. TEC; H.B. Fuller Construction Products Inc.
  - d. Mapei
  - e. Schluter Systems
- 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
- 3. Provide product that is approved by manufacturer for application thickness of 3/8" minimum.
- 4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.4.

## 2.8 GROUT MATERIALS

### A. Water-Cleanable Epoxy Grout GR1, GR2: ANSI A118.3.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Custom Building Products
  - b. Laticrete International, Inc.
  - c. TEC; H.B. Fuller Construction Products Inc.
  - d. Mapei

## 2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.
- B. Metal Edge Trim: Profile designed for wall terminations and edge protection.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Blanke Corporation
  - b. Ceramic Tool Company, Inc.
  - c. Schluter Systems L.P.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  - 4. Verify that required floor-mounted utilities are in correct location.
  - 5. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

- D. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- E. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- F. Substrate Flatness:
  - 1. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

### 3.3 INSTALLATION OF CERAMIC TILE SYSTEM

- A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.
- B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
  - 1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.
- C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.
  - 1. Allow crack isolation membrane to cure before installing tile or setting materials over it.
- D. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
  - 1. Add materials, water, and additives in accurate proportions.
  - 2. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.
- E. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Tile floors in wet areas.
    - b. Tile floors consisting of tiles 8 by 8 inches or larger.

- c. Tile floors consisting of rib-backed tiles.
  - 2. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
  - 3. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile. Ensure space is allowed for sealant joints.
  - 4. Provide trim shapes where necessary to eliminate exposed tile edges and as indicated on drawings.
  - 5. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
    - a. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
    - b. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
  - F. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, in accordance with TCNA EJ171 and where approved in shop drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.
  - G. Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
    - 1. Do not extend waterproof membrane or crack isolation membrane under thresholds set in modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproof membrane or crack isolation membrane with elastomeric sealant.
  - H. Metal Wall Trim: Install at locations indicated on Drawings.
- 3.4 FIELD QUALITY CONTROL
- A. Water Test:
    - 1. Test of waterproofing membrane in wet areas to be performed by Installation Contractor before setting tile.
      - a. Perform test after 24 hours of waterproof membrane installation.
      - b. Insert test plug in drain or waste line.
      - c. Check for leaks after 24 hours.
    - 2. Test to be witnessed by authorities having jurisdiction.

B. Nonconforming Work:

1. Waterproof membrane will be considered defective if water level has dropped.
2. Remove and replace defective components and retest.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.
- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove grout residue from tile as soon as possible.
  2. Clean grout smears and haze from tile in accordance with tile and grout manufacturer's written instructions. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.7 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
1. TCNA F122 (ground level); TCNA F122A (above ground): Thinset mortar with membrane.
    - a. Ceramic Tile Type: As indicated on drawings.
    - b. Thinset Mortar: Modified dry-set mortar.
    - c. Grout: Water-cleanable epoxy grout.
    - d. Crack Isolation Membrane: As recommended by setting material manufacturer.
    - e. Waterproof membrane: Provide full coverage bonded waterproof membrane in accordance with TCNA guidelines and manufacturer instructions for bathroom floor locations.

- f. Joint Width: Minimum recommended by tile manufacturer.
- g. Movement Joints: In accordance with TCNA EJ171 and as approved on shop drawings.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

- 1. TCNA W245: Thinset mortar on coated glass-mat water resistant gypsum backer units with membrane.
  - a. Ceramic Tile Type: As indicated on drawings.
  - b. Thinset Mortar: Modified dry-set mortar.
  - c. Grout: Water-cleanable epoxy grout.
  - d. Waterproof Membrane: Provide full coverage bonded waterproof membrane in accordance with TCNA guidelines and manufacturer instructions for bathroom wall locations.
  - e. Joint Width: Minimum recommended by tile manufacturer.
  - f. Movement Joints: In accordance with TCNA EJ171 and as approved on shop drawings.

END OF SECTION 093013

## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Acoustical panels (APC1)
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Related Requirements:

- C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

B. Sustainable Design Submittals:

1. Total recycled content based on product composition of post-consumer and pre-consumer (post-industrial) recycled content per FTC guidelines.

- C. Samples: For each exposed product and for each color and texture specified, 6 inches (150 mm) in size.

- D. Samples for Initial Selection: For components with factory-applied finishes.

- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.



3. Clips: Full-size hold-down.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Ceiling suspension-system members.
  2. Structural members to which suspension systems will be attached.
  3. Method of attaching hangers to building structure.
    - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
  4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
  5. Size and location of initial access modules for acoustical panels.
  6. Items penetrating finished ceiling and ceiling-mounted items including the following:
    - a. Lighting fixtures.
    - b. Diffusers.
    - c. Grilles.
    - d. Speakers.
    - e. Sprinklers.
    - f. Access panels.
    - g. Perimeter moldings.
  7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
  8. Minimum Drawing Scale: 1/8 inch = 1 foot.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra material, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
  - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.
  - 4. Impact Clips: Equal to 2 percent of quantity installed.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Sustainable Design Submittals: Contains greater than 50% total recycled content. Total recycled content based on product composition of post-consumer and pre-consumer (post-industrial) recycled content per FTC guidelines.

- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class A in accordance with ASTM E1264.
  - 2. Smoke-Developed Index: 50 or less.

## 2.3 ACOUSTICAL PANELS (APC1)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong World Industries, inc.
  - 2. USG Interiors, Inc. A subsidiary of USG Corporation
  - 3. Certain Teed Commercial Ceilings
- B. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Sustainable Design Submittals: Contains greater than 50% total recycled content. Total recycled content based on product composition of post-consumer and pre-consumer (post-industrial) recycled content per FTC guidelines.
- D. Classification: Provide panels as follows:
  - 1. Type and Form, Type IV: wet-formed mineral-fiber base with acoustically transparent membrane-faced overlay; Form 2. Binder shall not contain urea formaldehyde.
  - 2. Pattern: E lightly textured.
- E. Color: As indicated on Drawings.
- F. Light Reflectance (LR): Not less than 0.87.
- G. Ceiling Attenuation Class (CAC): Not less than 30.
- H. Noise Reduction Coefficient (NRC): Not less than 0.80.
- I. Articulation Class (AC): Not less than 170.
- J. Edge/Joint Detail: As indicated on drawings.
- K. Thickness: 7/8 inch.
- L. Modular Size: 24 by 24 inches.
- M. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

## 2.4 METAL SUSPENSION SYSTEM

- A. Provide suspension system from same manufacturer as Acoustical Panels.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.
  - 1. High-Humidity Finish: Where indicated, provide coating tested and classified for "severe environment performance" in accordance with ASTM C635/C635M.
- C. Narrow-Face, Double-Web, Steel Suspension System: Main and cross runners roll formed from hot-dipped galvanized steel sheet, with prefinished flanges of width indicated on drawings.
  - 1. Structural Classification: Heavy-duty system.
  - 2. End Condition of Cross Runners: Override.
  - 3. Face Design: Flat, flush.
  - 4. Cap Finish: Painted to match color indicated by manufacturer's designation.

## 2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
    - a. Type: Postinstalled expansion anchors.
    - b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.
    - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316.
    - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- (3.5-mm-) diameter wire.
- C. Hanger Rods: Mild steel, zinc-coated or protected with rust-inhibitive paint.

- D. Flat Hangers: Mild steel, zinc-coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.
- F. Hold-Down Clips: Manufacturer's standard hold-down.
- G. Impact Clips: Manufacturer's standard impact-clip system designated to absorb impact forces against acoustical panels.
- H. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Provide metal edge moldings and trim from same manufacturer as Acoustical Panels.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
  - 1. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
  - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.
  - 1. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.

Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  1. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends. Miter corners accurately and connect securely.
  2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- C. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- D. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
  1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans
  2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  3. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
  4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
  5. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
  6. Protect lighting fixtures and air ducts in accordance with requirements indicated for fire-resistance-rated assembly.

### 3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Periodic inspection during the installation of suspended ceiling grids in accordance with ASCE/SEI 7.
- B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
  1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
  2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- C. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.6 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113





## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Thermoplastic-rubber base (RB1, RB2, & RB3)
  - 2. Rubber molding accessories.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern specified.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg For more than 90 deg F.

#### 1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg For more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
  2. During installation.
  3. 48 hours after installation.
- B. After installation and until Project Acceptance, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg For more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 THERMOPLASTIC-RUBBER BASE

- A. Manufacturers: Provide products indicated on the drawings, or approved equal:
1. Johnsonite; A Tarkett Company.
  2. Flexco
  3. Roppe Corporation, USA.
    - a. Requests for substitutions for an approved equal will be considered in accordance with provisions of Section 016000 "Product Requirements" and Section 012513 "Product Substitution Procedures".
- B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).
1. Group: I (solid, homogeneous).
  2. Style and Location:
    - a. Style A, Straight: Provide in areas as indicated on drawings.
    - b. Style B, Cove: Provide in areas as indicated on drawings.
    - c. Style D, Sculptured: Provide in areas as indicated on drawings.
      - 1) Profile: As indicated on drawings.
- C. Thickness: As indicated on the drawings
- D. Height: As indicated on the drawings.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: As indicated on the finish schedule.

## 2.2 RUBBER MOLDING ACCESSORY

- A. Provide molding accessories from same manufacturer as Rubber Base.
- B. Locations: Provide rubber molding accessories in areas indicated.
- C. Colors and Patterns: As indicated by manufacturer's designations.

## 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

## 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within the range on pH scale recommended by manufacturer in writing. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter corners to minimize open joints.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Project Acceptance.

END OF SECTION 096513



## SECTION 096519.43 – POLYESTER COMPOSITION TILE FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Polyester Composition Tile Flooring (PCTF1)

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals.
- C. Shop Drawings: For each type of polyester composition tile.
  - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.
- B. Warranty.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.



1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  1. Coordinate mockups in this Section with mockups specified in other Sections.
    - a. Size: Minimum 100 sq. ft. for each type, color, and pattern .in locations directed by Interior Designer of Record.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Interior Designer of Record specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.
- C. Warranty: 15 Year Commercial.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 85 deg F.
- B. Store tiles on a flat surface and squarely on top of one another.
- C. Store away from vents and direct sunlight.
- D. When palletizing, first place a 5/8" or thicker plywood on the pallet. Stack 2 rows high side by side with no airspace between. Then quarter turn for 2 rows side by side. Do not exceed 12 boxes high. If you are stacking pallets, use a 1" thick plywood in between pallets.

#### 1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 50 deg F or more than 85 deg F in spaces to receive floor tile during the following periods:
  1. 7 days before installation.

2. During installation.
  3. 7 days after installation.
- B. Material and adhesive must be acclimated to the installation area for a minimum of 48 hours prior to installation.
- C. Humidity: The installation site's ambient relative humidity must not fall below 40%.
- D. After installation and until Final Acceptance, maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F more than 85 deg F.
- E. Close spaces to traffic during floor tile installation.
- F. Close spaces to traffic for 48 hours after floor tile installation.
- G. Install floor tile after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Sustainable Design: C2C Bronze Level (Version 3.1), Green Label Plus Certification

### 2.2 POLYESTER COMPOSITION TILE FLOORING (PCTF1)

- A. Manufacturers: Provide products indicated on the drawings, or approved equal:
1. Shaw Contract
  2. Patcraft
- a. Requests for substitutions for an approved equal will be considered in accordance with provisions of Section 016000 "Product Requirements" and Section 012513 "Product Substitution Procedures".
- B. Testing Requirements:
- b. Static Load/ASTM F 970 Passes, 1500 psi
  - c. Resistance to Chemicals/ASTM F925 Passes
  - d. Dimensional Stability/ISO 23999 Passes
  - e. Radiant Flux/ASTM E 648 Class I

- f. Smoke Density/ASTM E 662 <450
- C. Thickness: 0.158 in
- D. Size: As indicated on drawings.
- E. Colors and Patterns: As indicated on drawings.
- F. Installation: Installation: Direct Glue
- G. Construction: Non-Woven Composite.
- H. Fiber: Pet.
- I. Dye Method: 100% Solution Dyed.
- J. Backing: High Density Non-Woven Pet Composite.
- K. Tufted Weight: 75 oz/yd<sup>2</sup>.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of polyester composition tile flooring product.
- B. Concrete Substrates: Test for Internal Relative Humidity according to ASTM F 2170 and must not exceed requirements of the adhesive.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  - 3. Concrete floors shall be flat and smooth within 1/8" in 6 feet or 3/16" in 10 feet.

4. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 11 pH.
5. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas. Results must not exceed 99%.
  - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
  - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
  - c. Perform Bond testing to determine compatibility of adhesive to the substrate.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Substrates must be flat and smooth within 1/8" in 6 feet or 3/16" in 10 feet.
- E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  1. Lay tiles as indicated on drawings.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
- C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover floor tile until Final Acceptance.

END OF SECTION 096519.43

## SECTION 096536 - STATIC-CONTROL RESILIENT FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Static-control, vinyl composition floor tile (SF1)

- B. Related Requirements:

- 1. Section 096513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with static-control resilient flooring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For static-control resilient flooring, for tests performed by a qualified testing agency.
- C. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of static-control resilient flooring to include in maintenance manuals.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish one box for every 50 boxes, or fraction thereof, of each type, color, and pattern of floor tile installed.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in installation techniques required by manufacturer for specified static-control resilient flooring.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required for specified products.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store static-control resilient flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended in writing by manufacturer, but not less than 50 deg F or more than 90 deg F.
  - 1. Floor Tile: Store on flat surfaces.

## 1.8 PROJECT CONDITIONS

- A. Maintain ambient temperatures in spaces to receive static-control resilient flooring within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, during the following time periods:
  - 1. Period recommended in writing by manufacturer before installation.
  - 2. During installation.
  - 3. Period recommended in writing by manufacturer after installation.
- B. Until Final Acceptance, maintain ambient temperatures in installation areas within range recommended by manufacturer, but not less than 65 deg F or more than 85 deg F.
- C. Close spaces to traffic during static-control resilient flooring installation.
- D. Close spaces to traffic for period recommended in writing by manufacturer after static-control resilient flooring installation.
- E. Install static-control resilient flooring after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 STATIC-CONTROL, VINYL COMPOSITION FLOOR TILE SF1

- A. Manufacturers: Subject to compliance with requirements, provide products indicated on drawings or comparable products by one of the following:
  - 1. Flexco

2. Roppe
3. Tarkett

- B. Color: As indicated on drawings.
- C. Source Limitations: Obtain floor tile from single source from single manufacturer.
- D. Static-Control Properties: As determined by testing identical products in accordance with test method indicated by an independent testing and inspecting agency.
1. Electrical Resistance:
    - a. Material: Point-to-point and point-to-ground resistances between  $10^6$  ohms and  $10^9$  ohms when tested in accordance with ASTM F150.
    - b. Material in Combination with a Person: Average resistance of  $4.8 \times 10^8$  ohms when tested in accordance with ESD STM97.1.
  2. Static Generation: When tested in accordance with AATCC-134 , an average of less than 20 V when tested at 12 percent relative humidity with static-control footwear.
  3. Static Decay: 1000 to 100 V in maximum of 0.2 seconds at 12 percent relative humidity when tested in accordance with manufacturer's standard test protocol using an operator wearing static-control footwear and a static decay meter.
- E. Critical Radiant Flux: 0.45 W/sq. cm or greater in accordance with ASTM E648 or NFPA 253.
- F. Construction: ASTM F1700 – Solid Vinyl Tile Class 1, Type A, through pattern.
- G. Thickness: 1/8 inch.
- H. Size: 12 by 12 inches.
- I. Colors and Patterns: As indicated on Drawings.

## 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified portland cement or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Static-Control Adhesive: Provided or approved by manufacturer; type that maintains electrical continuity of floor-covering system to ground connection.
- C. Grounding Strips: Provided or approved by manufacturer; type and size that maintains electrical continuity of floor-covering system to ground connection.
- D. Floor Polish: Provide protective, static-control liquid floor polish products recommended in writing by floor-covering manufacturer.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with installation or static-control characteristics of floor coverings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates in accordance with manufacturer's written instructions to ensure successful installation of static-control resilient flooring and electrical continuity of floor-covering systems.
- B. Concrete Substrates: Prepare in accordance with ASTM F710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with floor-covering adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended in writing by manufacturer. Proceed with installation only after substrate alkalinity is not less than 6 or more than 8 pH unless otherwise recommended in writing by flooring manufacturer.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install static-control resilient flooring until it is same temperature as space where it is to be installed.
  - 1. Move static-control resilient flooring and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

- E. Sweep and vacuum substrates to be covered by static-control resilient flooring immediately before installation.

### 3.3 INSTALLATION, GENERAL

- A. Install static-control resilient flooring in accordance with manufacturer's written instructions.
- B. Extend grounding strips beyond perimeter of static-control resilient floor-covering surfaces to ground connections.
  - 1. For adhesively installed flooring, embed grounding strips in static-control adhesive.
- C. Scribe, cut, and fit static-control resilient flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
  - 1. Extend static-control resilient flooring below built-in items and permanent, but movable, items that allow for a flexible layout where indicated on Drawings.
- D. Extend static-control resilient flooring into toe spaces, door reveals, closets, and similar openings.
- E. Extend static-control resilient flooring to center of door openings where flooring or color transitions occur.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on static-control resilient flooring as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Adhesive Installation: Adhere static-control resilient flooring to substrates using a full spread of static-control adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.4 INSTALLATION OF FLOOR TILE

- A. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half floor tile at perimeter.
  - 1. Lay floor tiles square with room axis.
- B. Match floor tiles for color and pattern by selecting floor tiles from cartons in same sequence as manufactured and packaged if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.
  - 1. Lay vinyl composition floor tiles in pattern of colors and sizes indicated on Drawings.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to test electrical resistance of static-control resilient flooring in accordance with ASTM F150 and ESD STM7.1 for compliance with requirements.
  - 1. Arrange for testing after the following:
    - a. Static-control adhesives have fully cured.
    - b. Static-control resilient flooring has stabilized to ambient conditions.
    - c. Ground connections are completed.
- B. Static-control resilient flooring will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of static-control resilient flooring.
- B. Perform the following operations immediately after completing static-control resilient flooring:
  - 1. Remove static-control adhesive from exposed surfaces.
  - 2. Remove dirt and blemishes from exposed surfaces.
  - 3. Sweep and vacuum surfaces thoroughly.
  - 4. Damp-mop surfaces to remove marks and soil.
- C. Protect static-control resilient flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
  - 1. If recommended in writing by manufacturer, apply protective static-control floor polish formulated to maintain or enhance floor covering's electrical properties. Before polishing, do the following:
    - a. Ensure that static-control resilient flooring surfaces are free from soil, static-control adhesive, and surface blemishes.
    - b. Verify that both floor polish and its application method are approved by manufacturer and that floor polish will not leave an insulating film that reduces static-control resilient flooring's effectiveness for static control.
- D. Cover static-control resilient flooring and protect from rolling loads until Final Acceptance.

END OF SECTION 096536

## SECTION 096813 - TILE CARPETING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Carpet tile (CPT1, CPT2, & CPT3)

B. Related Requirements:

1. Section 096513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product and adhesive.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Shop Drawings: For carpet tile installation, showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern type, location, and direction.
6. Pile direction.
7. Type, color, and location of insets and borders.
8. Type, color, and location of edge, transition, and other accessory strips.
9. Transition details to other flooring materials.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of carpet tile.

1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

D. Samples for Verification: Actual sample of finished products for each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

### 1.3 CLOSEOUT SUBMITTALS

#### A. Maintenance Data: For carpet tiles. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

### 1.4 MAINTENANCE MATERIAL SUBMITTALS

#### A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but no fewer than 10 full-size units.

### 1.5 DELIVERY, STORAGE, AND HANDLING

#### A. Comply with CRI 104.

### 1.6 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended in writing by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

### 1.7 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, the following:
  - a. More than 10 percent loss of face fiber, edge raveling, snags, and runs.
  - b. Loss of tuft-bind strength.
  - c. Excess static discharge.
  - d. Delamination.
  - e. Dimensional instability.
3. Warranty Period: 20 years minimum from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 CARPET TILE CPT1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B.
  1. Mannington
  2. Patcraft; a division of Shaw Industries, Inc.
  3. Shaw Contract Group; a Berkshire Hathaway company
  4. Interface, LLC
  5. Milliken
  6. Mohawk Group
- C. Color: As indicated on drawings
- D. Pattern: As indicated on drawings
- E. Fiber Content: 100 percent solution dyed nylon 6
- F. Pile Characteristic: Multi-level pattern loop pile
- G. Density: 7500 oz./cu. yd. minimum
- H. Pile Thickness: .096 inches for finished carpet tile
- I. Stitches: 9 stitches per inch
- J. Gauge: 1/12 ends per inch
- K. Surface Pile Weight: 20 oz./sq. yd.
- L. Primary Backing/Backcoating: Manufacturer's standard composite materials
- M. Secondary Backing: Manufacturer's standard material.

- N. Size: As indicated on drawings
- O. Sustainable Design Requirements:
  - 1. Sustainable Product Certification: Gold level certification in accordance with NSF/ANSI 140.
- P. Performance Characteristics:
  - 1. Texture Appearance Retention Rating (TARR): Heavy traffic, 3.0 minimum in accordance with ASTM D7330.
  - 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm in accordance with NFPA 253.
  - 3. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
  - 4. Tuft Bind: Not less than 10 lbf in accordance with ASTM D1335.
  - 5. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
  - 6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
  - 7. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
  - 8. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.
  - 9. Electrostatic Propensity: Less than 3.5 kV in accordance with AATCC 134.

## 2.2 CARPET TILE CPT2

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B.
  - 1. Mannington
  - 2. Patcraft; a division of Shaw Industries, Inc.
  - 3. Shaw Contract Group; a Berkshire Hathaway company
  - 4. Interface, LLC
  - 5. Milliken
  - 6. Mohawk Group
- C. Color: As indicated on drawings
- D. Pattern: As indicated on drawings
- E. Fiber Content: 100 percent nylon and monofilament Type 6 and 6,6
- F. Pile Characteristic: Tufted, cut pile.
- G. Density: 4684 oz./cu. yd. minimum
- H. Pile Thickness: 0.17"
- I. Stitches: 9.5 stitches per inch

- J. Gauge: 5/32 ends per inch
- K. Surface Pile Weight: 24 oz./sq. yd.
- L. Total Weight: 125 oz./sq. yd. for finished carpet tile.
- M. Primary Backing/Backcoating: Manufacturer's standard composite materials
- N. Secondary Backing: Manufacturer's standard material
- O. Size: As indicated on drawings
- P. Sustainable Design Requirements:
  - 1. Sustainable Product Certification: Gold level certification in accordance with NSF/ANSI 140.
- Q. Performance Characteristics:
  - 1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm in accordance with NFPA 253.
  - 2. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
  - 3. Tuft Bind: Not less than 10 lbf in accordance with ASTM D1335.
  - 4. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
  - 5. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
  - 6. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
  - 7. Colorfastness to Light: Not less than 4 after 80 AFU (AATCC fading units) in accordance with AATCC 16E.
  - 8. Electrostatic Propensity: Less than 3.5 kV in accordance with AATCC 134.

## 2.3 CARPET TILE CPT3

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
- B.
  - 1. Mannington
  - 2. Patcraft; a division of Shaw Industries, Inc.
  - 3. Shaw Contract Group; a Berkshire Hathaway company
  - 4. Interface, LLC
  - 5. Milliken
  - 6. Mohawk Group
- C. Color: As indicated on drawings
- D. Pattern: As indicated on drawings
- E. Fiber Content: 100 percent solution dyed nylon 6



- F. Pile Characteristic: Multi-level pattern loop pile
- G. Density: 7200 oz./cu. yd. minimum
- H. Pile Thickness: 0.1 inches for finished carpet tile.
- I. Stitches: 9 stitches per inch
- J. Gauge: 1/12 ends per inch
- K. Surface Pile Weight: 20 oz./sq. yd.
- L. Primary Backing/Backcoating: Manufacturer's standard composite materials
- M. Secondary Backing: Manufacturer's standard material
- N. Size: As indicated on drawings
- O. Sustainable Design Requirements:
  - 1. Sustainable Product Certification: Gold level certification in accordance with NSF/ANSI 140.
- P. Performance Characteristics:
  - 1. Texture Appearance Retention Rating (TARR): Heavy traffic, 3.0 minimum in accordance with ASTM D7330.
  - 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm in accordance with NFPA 253.
  - 3. Dry Breaking Strength: Not less than 100 lbf in accordance with ASTM D2646.
  - 4. Tuft Bind: Not less than 10 lbf in accordance with ASTM D1335.
  - 5. Delamination: Not less than 4 lbf/in. in accordance with ASTM D3936.
  - 6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
  - 7. Colorfastness to Crocking: Not less than 4, wet and dry, in accordance with AATCC 165.
  - 8. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) in accordance with AATCC 16.3 Option 3.
  - 9. Electrostatic Propensity: Less than 3.5 kV in accordance with AATCC 134.

## 2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended in writing by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive types to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and that are recommended in writing by carpet tile manufacturer for releasable installation.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, in accordance with manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns as indicated on Drawings and as recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended in writing by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders and as indicated on drawings.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive and other surface blemishes using cleaner recommended in writing by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

## SECTION 098433 - SOUND-ABSORBING WALL UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general conditions of the contract, including general and supplementary conditions and division 1 specification sections, apply to the work of this section.

#### 1.2 SUMMARY

- A. Section includes:
  - 1. Sound-absorptive panels (SAW1)
- B. Related Sections:
  - 1. Section 092116.23 – Gypsum Board Shaft Wall Assemblies

#### 1.3 SUBMITTALS

- A. Product Data: Manufacturer's technical data and installation instructions for each type of wall panel, panel edge, core material, and mounting indicated.
- B. Certifications: Certified test reports showing compliance with performance requirements specified.
- C. Samples:
  - 1. Submit a minimum of three (3) samples of each panel type and finish type required. Include samples that show the range of variation expected in grain, texture and color.
  - 2. Mounting Devices: Full-size Samples.
  - 3. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.
- D. Shop Drawings: Submit shop drawings, including details, for all surfaces. Coordinate wall panel layout, installation, and suspension system components. Show overall layout with dimensions and details of penetrations and intersections with other materials or building components.
  - 1. Include plans, elevations, sections, and mounting devices and details.
  - 2. Include details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge profile and core materials.
  - 3. Include details at cutouts and penetrations for other work.
  - 4. Include direction of fabric weave and pattern matching.

- E. Submit operation and maintenance data for installed products. Include precautions relating to harmful cleaning materials and methods that would affect the service life of the panels.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets, switches, and thermostats.
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
    - f. Access panels.
  - 2. Show operation of hinged and sliding components covered by or adjacent to units.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sound absorbing wall panels: For each finish installed, provide length equal to 5 percent of amount installed.
  - 2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than two devices, including unopened adhesives.

#### 1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide acoustic panels from a single manufacturer with at least 5 years of prior experience fabricating projects of similar size and complexity.
- B. Installer: Installation shall be done by qualified carpenters with at least 2 year's experience in the installation of architectural woodwork or acoustical systems. Installers must receive training on handling, cutting, machining and field finishing the specified product prior to receiving materials on site.
- C. Fire Performance Characteristics: Class A as tested by an independent accredited testing facility. Tests: ASTM E84. Flame spread: 25 or less. Smoke developed: 450 or less as specified by state or local codes.

- D. Coordination of Work: Installing contractor shall organize and conduct a pre-installation survey of temperature, humidity and construction elements attaching, penetrating or concealed behind the acoustic wall panels.
- E. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
  - 1. Build mockup of typical wall area 48 inches wide by full height. Include intersection of wall and ceiling, corners, and perimeters.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

#### 1.7 REFERENCES

- 1. ASTM C423 Sound absorption and sound absorption coefficients by the reverberation room method performed by an independent testing agency.
- 2. ASTM E84 Standard test method for surface burning characteristics of building materials.
- 3. ASTM D1037 Linear expansion with change in moisture content.
- 4. Standard Method Version 1.2 for CDPH01350 Volatile organic compounds.

#### 1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver panels to the project in original, unopened packages. Inspect containers for visible damage and report any questionable condition to the shipper and manufacturer immediately.
- B. Store products in a fully enclosed, clean, dry space out of direct sunlight and protected from damage with temperature controlled between 50 and 86 degrees F.
- C. Handle products carefully to avoid damaging panel surfaces or chipping edges. Report any damage immediately. The installation of damaged panels is not covered by the manufacturer's warranty.

#### 1.9 PROJECT CONDITIONS

- A. Do not install acoustic panels until space is enclosed and weather-proofed, wet work is completely dry and ambient temperature and humidity conditions are maintained at the levels indicated for the project when occupied for its intended use.
- B. Permit panels to reach room temperature, 50 to 86 degrees F, and stabilized moisture content of 25% to 55% RH for at least 72 hours before installation per AWI standards. Building should be enclosed and HVAC systems functioning in continuous operation with relative humidity maintained between 25 and 55 percent.

- C. Lighting: Do not install units until a permanent level of lighting is provided on surfaces to receive the units.
- D. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- E. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication and indicate them on Shop Drawings.

#### 1.10 WARRANTY

- A. Provide manufacturer's standard one-year written product warranty per Section 01770 – Closeout Procedures
- B. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to the following:
    - a. Acoustical performance.
    - b. Fabric sagging, distorting, or releasing from panel edge.
    - c. Warping of core.
  - 2. Warranty Period: One year from date of Final Acceptance.

#### 1.11 MAINTENANCE

- A. Maintenance Instructions: Provide manufacturer's standard maintenance and cleaning instructions for finishes provided.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Manufacturers: Provide products indicated on the drawings, or approved equal:
  - 1. Soundply by Navy Island
  - 2. Certainteed
  - 3. Armstrong World Industries
  - 4. ASI
    - a. Requests for substitutions for an approved equal will be considered in accordance with provisions of Section 016000 "Product Requirements" and Section 012500 "Substitution Procedures."

- B. Sound-Absorbing Wall Panel (SAW1):
1. Acoustical Panels: Real wood veneer laminated to a fiberglass reinforced polymer or a UV printed/painted surface applied to an MDF skin. Surface skin thickness shall not be less than 1.5mm (0.060"). The core of the panels shall be comprised of a Class A sintered resin-reinforced glass wool.
- C. Panel Edge Treatment: Panels will be edge banded with the matching materials and finish, to match with the panel face.
- D. Reveal Options:
1. Closed: As indicated on drawings.
- E. Panel Weight: 1.8 lbs.
- F. Panel Sizes: As indicated in drawings.
- G. Panel Thickness: As indicated in drawings.
- H. Flame Resistance: Class 1(A) rating based on ASTM E84 standard test method for surface burning characteristics in building materials. Depending on the use and the type of veneer selected, Latus Panels can be used in Class A environments (IBC Chapter 8 Section 803)
- I. Perforations: Panels will be furnished with perforated faces consisting of 0.5mm (0.02") diameter holes in an offset pattern. The perforations must be clean without rounded edges or grain pull out between perforations. A minimum of 99.5% of the perforations must be acoustically functional, providing unobstructed passage into the core. Perforations must maintain consistent diameter through the face material and backer with no tapering or roughness.
- J. Acoustic Performance: To generate the standing sound waves required for resistive absorption, each panel must have an acoustically reflective back surface that extends the panel's full length and width. Each panel must achieve a minimum NRC test value as stated without any cavity space or back loading: Select:
1. .80 NRC
- K. Panel Stability: Linear contraction or expansion to not exceed 0.4% maximum variation in width or height per ASTM D1037.
- L. VOC Emissions: Panels must be third party certified to be in compliance with CDPH01350 for volatile organic compounds.
- M. Finish for Veneer Faced Panels:
1. Species: as indicated on drawings.
  2. Cut: plain sliced.
  3. Matching veneer leaves: slip matching.



4. Matching between panels: end matched.
5. Finish: as indicated on drawings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Inspect installation area and conditions under which work is to be performed for compliance with all manufacturer's environmental requirements. All wet work in the installation area must be complete, cured and dry prior to installation. Do not proceed until all unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Installation must be done by qualified carpenters with 2 years experience in the installation of architectural woodwork or acoustic systems. The firm must demonstrate successful experience installing materials of similar type and quality of those required for this project. The use of proper carpentry tools and techniques will be required for the installation.
- B. Comply with manufacturer's instruction and recommendations for hanging panels.
- C. Confirm all field dimensions are coordinated with shop drawings.

#### 3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation of Joint Width: Not more than 1/16-inch variation from reveal line in 48 inches, noncumulative.

#### 3.4 ADJUSTING AND CLEANING

- A. Clean soiled surfaces of panels per manufacturer's instructions.
- B. Remove and replace damaged or discolored materials not in compliance with manufacturer's tolerances.
- C. Cover and protect panels from damage until project completion.

END OF SECTION 098433

## SECTION 099113 - EXTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Concrete.
  - 2. Concrete masonry units (CMUs).
  - 3. Steel and iron.
  - 4. Galvanized metal.
  - 5. Aluminum (not anodized or otherwise coated).
  - 6. Wood
  - 7. Gypsum board.

#### 1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Sustainable Design Submittals:
  - 1. Product Data: For paints and coatings, indicating VOC content.

- C. Samples: For each type of paint system and each color and gloss of topcoat.

#### 1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide the Basis-of-Design product indicated on the Finish Schedule or comparable product by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. PPG Architectural Finishes, Inc.
  - 3. Sherwin-Williams Company (The).

#### 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMUs): 12 percent.
  - 3. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

#### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE (Sherwin-Williams, Basis of Design)

#### A. Steel and Iron Substrates:

- 1. Water-Based Light Industrial Coating System MPI EXT 5.1M:
  - a. Prime Coat: Primer, epoxy, anti-corrosive MPI #101.
    - 1) Sherwin-Williams Dura-Plate 235 Multi-Purpose Epoxy.
  - b. Prime Coat: Shop primer specified in Section where substrate is specified.
  - c. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
  - d. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
    - 1) Sherwin-Williams Pro Industrial DTM Acrylic Eg-Shel.

#### B. Galvanized-Metal Substrates:

- 1. Water-Based Light Industrial Coating System MPI EXT 5.3J:
  - a. Prime Coat: Primer, galvanized, water based, MPI #134.
    - 1) Sherwin-Williams Pro Industrial DTM Acrylic Primer/Finish.
  - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
  - c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.
    - 1) Sherwin-Williams Pro Industrial DTM Acrylic Eg-Shel.

#### C. Aluminum Substrates:

- 1. Water-Based Light Industrial Coating System MPI EXT 5.4G:
  - a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.
  - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.

- c. Topcoat: Light industrial coating, exterior, water based (MPI Gloss Level 3), MPI #161.

- 1) Sherwin-Williams Pro Industrial DTM Acrylic Eg-Shel.

D. Exterior Gypsum Board Substrates:

1. Latex System MPI EXT 9.2A:

- a. Prime Coat: Primer, latex for exterior wood (reduced), MPI #6.
  - 1) Sherwin-Williams Multi-Purpose Latex Primer/Sealer.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.
  - 1) Sherwin-Williams, Duration Exterior Acrylic Satin.

END OF SECTION 099113



## SECTION 099124 - INTERIOR PAINTING (MPI STANDARDS)

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Concrete Substrates, Traffic Surfaces.
  - 2. Steel and iron.
  - 3. Gypsum board.
- B. Related Requirements:
  - 1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
  - 2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
  - 3. Section 057300 "Decorative Metal Railings"
  - 4. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

#### 1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.



#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- C. Product List: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) each material and color applied.

#### 1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Basis of Design product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
  - a. Sherwin Williams
  - b. Benjamin Moore
  - c. PPG

#### 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
  1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

- C. Colors: As indicated on drawings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Fiber-Cement Board: 12 percent.
  - 3. Masonry (Clay and CMUs): 12 percent.
  - 4. Wood: 15 percent.
  - 5. Gypsum Board: 12 percent.
  - 6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
  1. SSPC-SP 2.
  2. SSPC-SP 3.
  3. SSPC-SP 7/NACE No. 4.
  4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
  1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  2. Sand surfaces that will be exposed to view, and dust off.
  3. Prime edges, ends, faces, undersides, and backsides of wood.
  4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### 3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
    - a. Equipment, including panelboards and switch gear.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Tanks that do not have factory-applied final finishes.
    - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering
  2. Paint the following work where exposed in occupied spaces:
    - a. Equipment, including panelboards.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - h. Other items as directed by Interior Designer of Record.
  3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Traffic Surfaces:
  - 1. Water-Based Concrete Floor Sealer System , MPI INT 3.2G:
    - a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
    - b. Topcoat: Sealer, water based, for concrete floors, MPI #99.
- B. Steel Substrates:
  - 1. Quick-Dry Enamel System , MPI INT 5.1A :
    - a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
    - b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
    - c. Topcoat: Alkyd, quick dry, semigloss (MPI Gloss Level 5), MPI #81 .
- C. Wood Substrates: (MDF Trim and MDF Wall Paneling)

1. High-Performance Architectural Latex System, MPI INT 6.3A:
  - a. Prime Coat: Primer, latex, for interior wood, MPI #39.
  - b. Intermediate Coat: Latex, interior, high performance Architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance Architectural (MPI Gloss Level 3), MPI #139.

D. Gypsum Board Substrates:

1. High-Performance Architectural Latex System, MPI INT 9.2B:
  - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
  - b. Intermediate Coat: Latex, interior, high performance Architectural, matching topcoat.
  - c. Topcoat: Latex, interior, high performance Architectural (MPI Gloss Level 3), MPI #140.

END OF SECTION 099124

## SECTION 099300 - STAINING AND TRANSPARENT FINISHING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Wood Stains
  - 2. Transparent Finishes
- B. Section includes surface preparation and application of wood finishes on the following substrates:
  - 1. Exterior Substrates:
    - a. Exposed dimension lumber (rough carpentry).
    - b. Dressed lumber (finish carpentry).
  - 2. Interior Substrates:
    - a. Dressed lumber (finish carpentry).
- C. Related Requirements:
  - 1. Division 09 Section "Exterior Painting" for standard paint systems on exterior substrates.
  - 2. Division 09 Section "Interior Painting" for stains and transparent finishes on concrete floors.

#### 1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Product List: For each product indicated, include the following:



1. Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. of each material and color applied.

#### 1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Architect and Interior Designer of Record will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  2. Final approval of stain color selections will be based on mockups.
    - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect and Interior Designer of Record at no added cost to Owner.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

#### 1.8 FIELD CONDITIONS

- A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply finishes when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior finishes in snow, rain, fog, or mist.

### PART 2 - PRODUCTS

#### 2.1 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. Benjamin Moore & Co.
  2. Columbia Paint
  3. Duron, Inc.

4. Sherwin-Williams Company (The).
5. Cabot

- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the category indicated.

## 2.2 MATERIALS, GENERAL

- A. Material Compatibility:
1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.

## 2.3 WOOD STAINS

- A. Stain, Exterior, Solvent Based, Clear. (Factory Coat Finish – interior and exterior)
1. Sherwin-Williams, 105.43 Deckscapes, Exterior Deck Stain Clear Sealer A15T260.

## 2.4 SOLVENT-BASED VARNISHES

- A. Varnish, with UV Inhibitor, Exterior, Semi-Gloss (Gloss Level 5): MPI #30.
1. Sherwin-Williams, Minwax: Helmsman Spar Varnish Semi-Gloss.
  2. Columbia Paint, Wood Finishes: Master Spar Varnish Semi-Gloss.

## 2.5 POLYURETHANE VARNISHES

- A. Varnish, Interior, Polyurethane, Oil-Modified, Satin (Gloss Level 4): MPI #57.
1. Sherwin-Williams, Minwax: Polyurethane Varnish Satin.
  2. Benjamin Moore, Benwood: Polyurethane Finish Low Lustre.
  3. Columbia Paint, Wood Finishes: Polyurethane Varnish Satin.
  4. Duron Paints: Polyurethane Satin Interior finish.

## 2.6 SOURCE QUALITY CONTROL

- A. Testing of Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
  2. Testing agency will perform tests for compliance with product requirements.
  3. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished

with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
  - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
  - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.
  - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
- D. Exterior Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Prime edges, ends, faces, undersides, and backsides of wood.
    - a. For solid hide stained wood, stain edges and ends after priming.
    - b. For varnish coated stained wood, stain edges and ends and prime with varnish. Prime undersides and backsides with varnish.
  - 3. Countersink steel nails, if used, and fill with putty or plastic wood filler tinted to final color. Sand smooth when dried.
- E. Interior Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
3. Sand surfaces that will be exposed to view and dust off.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

### 3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  1. Use applicators and techniques suited for finish and substrate indicated.
  2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
  3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

### 3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood substrates, nontraffic surfaces, including wood trim, architectural woodwork and wood-based panel products.
  1. Sherwin-Williams, 105.43 Deckscapes, Exterior Deck Stain Clear Sealer A15T260 (for Factory Coat Finish for all exterior wood siding, heavy timber columns, glue-lam beams and CLT)
  2. Polyurethane Varnish System: (For heavy timber columns, glue-lam beams, and CLT decking)
    - a. Prime Coat: Polyurethane varnish matching topcoat.
    - b. Intermediate Coat: Polyurethane varnish matching topcoat.
    - c. Topcoat: Varnish, interior, polyurethane, oil-modified, satin (Gloss Level 4), MPI #57.
  - 3.

### 3.6 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

- A. Wood substrates, nontraffic surfaces, including wood trim, architectural woodwork and wood-based panel products.
  - 1. Sherwin-Williams, 105.43 Deckscapes, Exterior Deck Stain Clear Sealer A15T260 (for Factory Coat Finish for all interior wood siding, heavy timber columns, glue-lam beams and CLT)
  - 2. Polyurethane Varnish System: (For wood handrails and trim.)
    - a. Prime Coat: Polyurethane varnish matching topcoat.
    - b. Intermediate Coat: Polyurethane varnish matching topcoat.
    - c. Topcoat: Varnish, interior, polyurethane, oil-modified, satin (Gloss Level 4), MPI #57.

END OF SECTION 099300

## SECTION 099600 - HIGH-PERFORMANCE COATINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of high-performance coating systems on the following substrates:
  - 1. Interior Substrates:
    - a. Gypsum board in Restrooms and Shower Rooms.
- B. Related Requirements:
  - 1. Section 051200 "Structural Steel Framing" and Section 053100 "Steel Decking" for shop priming of structural steel with primers specified in this Section.
  - 2. Section 099113 "Exterior Painting" for general field painting.
  - 3. Section 099124 "Interior Painting" for general field painting.

#### 1.3 DEFINITIONS

- A. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- B. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- C. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 2. Indicate VOC content.
- B. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.

1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

- C. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Coatings: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

#### 1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each coating system.
    - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
    - b. Other Items: Architect will designate items or areas required.
  2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

## 1.8 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
  - a. Sherwin Williams
  - b. Benjamin Moore
  - c. PPG

### 2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
  - 3. Products shall be of same manufacturer for each coat in a coating system.
- C. Colors: As indicated on drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.



- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

### 3.3 APPLICATION

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
  - 1. Use applicators and techniques suited for coating and substrate indicated.
  - 2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  - 1. Contractor shall touch up and restore coated surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

### 3.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE.

- A. Gypsum Board Substrates in Restrooms and Shower Rooms:
  - 1. Epoxy-Modified Latex System MPI INT 9.2F:
    - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
    - b. Intermediate Coat: Epoxy-modified latex, matching topcoat.
    - c. Topcoat: Epoxy-modified latex, semi-gloss (MPI Gloss Level 5), MPI #215.

END OF SECTION 099600



## SECTION 101100 - VISUAL DISPLAY UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Visual display board assemblies. VDU1 & VDU2

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
2. Include electrical characteristics for motorized units.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.

C. Samples and color charts:

1. Provide Manufacturer's color charts and composition samples of face, core, backing and trim to illustrate finish, color and texture, where required.

D. Samples for Verification: For each type of visual display unit indicated.

1. Visual Display Panel: Not less than 8-1/2 by 11 inches, with facing, core, and backing indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch-long sections of each trim profile.
3. Display Rail: 6-inch-long section of each type.
4. Rail Support System: 6-inch-long sections.
5. Accessories: Full-size Sample of each type of accessory.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturer's special warranties.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For visual display units to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLY, VDU1 & VDU2

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:
  - 1. Aarco Products, Inc.
  - 2. Claridge Products and Equipment, Inc.
  - 3. MooreCo Inc.
- B. Requests for substitutions for an approved equal will be considered in accordance with provisions of Section 016000 "Product Requirements" and Section 012500 "Substitution Procedures."
- C. Visual Display Board Assembly.
  - 1. Assembly: Markerboard.
  - 2. Corners: Square.
  - 3. Width: As indicated on Drawings.
  - 4. Height: As indicated on Drawings.
  - 5. Mounting Method: Mechanically fastened in accordance with manufacturer's recommendations.

- D. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
  - 1. Color: White.
  - 2. Premium writing surface.
  - 3. Projectable surface.
  - 4. Low reflectivity.
  - 5. Accepts magnetic accessories.
  - 6. Bacteria resistant.
- E. Aluminum Frames and Trim: Frameless with no visible hardware for a “floating” appearance.
- F. Accessories: Provide each of the following accessories for each visual display board:
  - 1. Rare earth magnets; Qty=5; 1.29”h x 1.29”w; .44” thick, rounded corners, gray
  - 2. Marker caddy; Qty=1; 4”h, 8 1/2”w, 2 2/5”d; Large magnetic holder with divider for up to 14 markers, cleaners and erasers.
  - 3. Magnetic Eraser; Qty=3; 2 1/8”h, 4 1/2”w, 7/8”d; Black felt eraser with strong rare earth magnets

## 2.3 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. MDF: ANSI A208.2, Grade 130.
- C. Extruded Aluminum: ASTM B221, Alloy 6063.

## 2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.

#### 3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.
- C. Deliver completely assembled in one piece, wherever possible.
- D. Follow manufacturer's instructions for storage and handling of units before installation.
- E. Install level and plumb, in accordance with manufacturer's recommendations.

#### 3.4 CLEANING AND PROTECTION

- A. Verify that all accessories are installed as required for each unit.

- B. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable "cleaning instructions" label to visual display unit in each room.
- C. Touch up factory-applied finishes to restore damaged or soiled areas.
- D. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100





## SECTION 101400 - SIGNS

### PART 1 - GENERAL

#### 1.1 SUMMARY:

- A. Section Includes:
  - 1. Exterior building signs composed of aluminum dimensional letters.
- B. Related Sections:
  - 1. Temporary project signs: Division 1.
  - 2. Elevator door jamb markings: Division 14.
  - 3. Mechanical identification: Division 15.
  - 4. Electrical identification: Division 16.
  - 5. Illuminated exit signs: Division 16.

#### 1.2 QUALITY ASSURANCE

- A. Supplier: Obtain all products from a single supplier.
- B. Regulatory Requirements: Products shall meet the requirements of the Americans with Disabilities Act and the 2018 N. C. State Building Code with ICC/ANSI A117.1-2009.

#### 1.3 SUBMITTALS

- A. Product Data: Submit for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
- B. Shop drawings:
  - 1. Show fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
  - 2. Provide message list for each sign required, including large-scale details of wording and lettering layout.
  - 3. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
  - 4. Provide signage schedule for all signs designating signage text, room numbers, and location.
- C. Samples:
  - 1. Submit manufacturer's full range of samples for initial selection of color, pattern, and texture:

#### 1.4 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where necessary to ensure proper fitting. Show recorded measurements on final shop drawings.

#### 1.5 EXTRA MATERIALS

- A. Provide Owner with 1 copy of the Manufacturer's standard software used for making room name message inserts.
- B. Provide Owner with 2 packages (min. 100 sheets) of paper for making room name message inserts.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Submit manufacturer's warranty executed by authorized company official.
  - 1. Warranty Period: Three years from Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 ALUMINUM DIMENSIONAL LETTERS

- A. Exterior Building Identification Signs:
  - 1. Material: .250 inch thick aluminum.
  - 2. Height: 6 inches.
  - 3. Letter Style: Helvetica Medium.
  - 4. Finish: Clear anodized.
  - 5. Schedule:

	Bldg. No.	Building Name
a. Maritime Education Center	(5 digits)	(Max. 25 letters)
b. Visitor Center	(5 digits)	(Max. 25 letters)
- B. Materials and Components:
  - 1. Supports, Fixtures and End Caps: As required for a complete and finished installation.
  - 2. Mounting Hardware: Manufacturer's standard mounting system for location and type of installation indicated on the signage drawings.
  - 3. Wall mount: Use 1/2 inch stainless steel stand-off spacers with stainless steel expansion insert or toggle fasteners.

### 2.2 FABRICATION - GENERAL

- A. General:
  - 1. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
  - 2. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions.
- B. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassemble signs only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
- C. Conceal fasteners if possible; otherwise, locate fasteners to appear inconspicuous.
- D. Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color, and details of construction.
- E. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with manufacturer's instructions.
- B. Proceeding with installation implies installer's acceptance of substrate and conditions.

#### 3.2 INSTALLATION

- A. Install product in accordance with manufacturer's instructions.
- B. Install sign units and accessories where indicated, using mounting methods of the type described and free from distortion, warp, or defect adversely affecting appearance.
- C. Install signs level, plumb, and at the height indicated
- D. Install product at heights to conform to ICC A117.1-2009 of the North Carolina State Building Code 2018.
- E. Install signs within the following tolerances and in accordance with manufacturer's recommendations:

#### 3.3 LEANING, PROTECTION, AND REPAIR

- A. Repair scratches and other damage which might have occurred during installation. Replace components where repairs were made but are still visible to the unaided eye from a distance of 5 feet.
- B. Remove temporary coverings and protection to adjacent work areas. Clean installed products in accordance with manufacturer's instructions prior to acceptance.
- C. Building Signage Schedule: Location as indicated. Aluminum plate letters as follows:

BUILDING	BUILDING NO.	NAME	COMMENTS
Maritime Education Center	(5 digits max.)	(25 digits max.)	
Visitor Center	(5 digits max.)	(25 digits max.)	

END OF SECTION 101400



## SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. ICC A117.1-2009. Accessible and Useable Buildings and Facilities

#### 1.2 SUMMARY

- A. Section includes code required, wayfinding, and room-identification signs that are directly attached to the building.

#### 1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

#### 1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For code required, wayfinding, and room-identification signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
  - 1. Include representative Samples of available typestyles and graphic symbols.

- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Room-Identification Signs type A-1, A-2, & B-1: Full-size Sample.
  - 2. Variable Component Materials: 8-inch (200-mm) Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
  - 3. Exposed Accessories: Full-size Sample of each accessory type.
  - 4. Full-size Samples, if approved, will be returned to Contractor for use in Project only upon written request.
- E. Product Schedule: Use same designations indicated on Drawings or specified.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Variable Component Materials: 12 replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
  - 2. Tools: two sets of specialty tools for assembling signs and replacing variable sign components.

#### 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by the manufacturer.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:

- a. Deterioration of finishes beyond normal weathering.
  - b. Deterioration of embedded graphic image.
  - c. Separation or delamination of sheet materials and components.
2. Warranty Period: Two years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design."

### 2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  1. Basis-of-Design: As indicated on signage detail sheet.
  2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. APCO Graphics, Inc.
    - b. ASI Sign Systems, Inc.
    - c. InPro Corporation.
    - d. Takeform.
- B. Signage System:
  1. All signs shall have a matching appearance and be constructed utilizing the same manufacturing processes to ensure a consistent look throughout.

### 2.3 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209 (ASTM B209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B221 (ASTM B221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.



- D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

## 2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  - 1. Use concealed fasteners and anchors unless indicated to be exposed.
  - 2. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
  - 3. Sign Mounting Fasteners:
    - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
- D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
  - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
  - 1. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner. Furnish two blank inserts for each sign for Owner's use.
  - 2. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. Subsequent changeable sign panels are by Owner.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

- a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
  - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Concealed Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position and push to engage tape adhesive.
4. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch (6.35 mm) away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.

### 3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. Upon completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

## SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes: Solid-plastic toilet compartments (TP1)
- B. Related Requirements:
  - 1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
  - 2. Section 092216 "Non-Structural Metal Framing" for blocking.
  - 3. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

#### 1.2 COORDINATION

- A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling.

#### 1.3 ACTION SUBMITTALS

- A. Product Data:
  - 1. Solid-plastic toilet compartments:
    - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.
- B. Shop Drawings: For solid-plastic toilet compartments.
  - 1. Include plans, elevations, sections, details, and attachment details.
  - 2. Show locations of cutouts for compartment-mounted toilet accessories.
  - 3. Show ceiling-mounted items, and overhead support or bracing locations.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of toilet compartment material indicated.
  - 1. Include Samples of hardware and accessories involving material and color selection.
- D. Samples for Verification: Actual sample of finished products for each type of toilet compartment indicated.
  - 1. Size: 6-inch-square, of same thickness indicated for Work.

2. Include each type of hardware and accessory.

- E. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: 10 fasteners of each size and type.

#### 1.6 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Department of Justice "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.
- C. Toilet compartment panels and doors: Comply with emissions requirements of CDPH Standard Test Method in Section 018113.

#### 2.2 SOLID-PLASTIC TOILET COMPARTMENTS TP1

- A. Manufacturers: Provide products indicated on the drawings, or approved equal:
1. Scranton

2. Columbia Patitions
3. ASI
  - a. Requests for substitutions for an approved equal will be considered in accordance with provisions of Section 016000 "Product Requirements" and Section 012513 "Product Substitution Procedures".

B. Toilet-Enclosure Style: Floor Mounted - Overhead Braced.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color and Pattern: One color and pattern as selected by Interior Designer of Record from manufacturer's full range.

E. Pilaster Sleeves (Caps): Manufacturer's standard design; stainless steel.

F. Urinal-Screen Construction: Matching panel construction.

G. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

## 2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Continuous Manufacturer's minimum 0.062-inch-thick stainless steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through bolts.
2. Continuous Flat Plate Strike stainless steel Panel Privacy Plate at gap between doors – manufacturers standard thickness but not less than 0.031 inches.
3. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast-stainless steel latch unit, designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
  - a. Provide Occupancy Indicator
4. Coat Hook: Manufacturer's heavy-duty combination cast-stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.

- 5. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast-stainless steel bumper at outswinging doors and entrance-screen doors. Mount with through bolts.
  - 6. Door Pull: Manufacturer's heavy-duty, cast-stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.
- B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

## 2.4 MATERIALS

- A. Aluminum Castings: ASTM B26/B26M.
- B. Aluminum Extrusions: ASTM B221.
- C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.
- D. Stainless Steel Castings: ASTM A743/A743M.
- E. Zamac: ASTM B86, commercial zinc-alloy die castings.
- F. Plastic Panels: High density polyethylene (HDPE) suitable for exposed applications, waterproof, non-absorbent, and graffiti-resistant textured surface.
  - 1. Recycled Content; Post Consumer: 100 percent.

## 2.5 FABRICATION

- A. Overhead-Braced Units: Manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters and walls to suit floor and wall conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- B. Urinal-Screen Posts: Manufacturer's standard corrosion-resistant anchoring assemblies at posts and walls, with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves caps at posts to conceal anchorage.
- C. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

- D. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet compartments and 36-inch-wide, inswinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
  - 1. Confirm location and adequacy of blocking and supports required for installation.
    - 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION OF PLASTIC TOILET COMPARTMENTS

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  - 2. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
- B. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.
- C. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.
- D. Finished surfaces shall be cleaned after installation and be left free of imperfections.



3.3 ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

3.4 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Final Acceptance.

END OF SECTION 102113.19

## SECTION 102239 – FOLDING PARTITIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Operable Acoustical Panel Partitions - Section includes motorized electrically operated continuously hinged (train) panel type partition, including ceiling track, ceiling guards, and operating hardware. Contractor shall provide labor and materials necessary to install operable partitions in location as indicated on the drawings

##### B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach supporting tracks to overhead structural system.
2. Section 092916 "Non-Structural Metal Framing" for construction around the ceiling track
3. Electrical and communications Sections for electrical service and connections for motor operators, controls, and limit switches and for system disconnect switches.

#### 1.2 DEFINITIONS

- A. NIC: Noise Isolation Class.
- B. NRC: Noise Reduction Coefficient.
- C. STC: Sound Transmission Class.

#### 1.3 PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site, at a minimum of 2-weeks prior to the start of installation.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product, include material descriptions, construction details, finishes, installation details and operating instructions for each type of operable partition, component and accessory specified.
- B. Shop Drawings: For operable panel partitions.
  1. Include plans, elevations, sections, details, and attachments to other work.

2. Indicate stacking and operating clearances. Indicate location and installation requirements for hardware and track, blocking, and direction of travel.
  3. Include dimensions, weights, conditions at openings and at storage areas, and required installation, and storage clearances.
  4. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of exposed material, finish, covering, or facing. Selection samples shall be provided demonstrating the manufacturer's full range of finishes available.
1. Include Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed material, finish, covering, or facing, prepared on Samples of size indicated below:
1. Textile Facing Material: Provide minimum 24-inch square section of carpet from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat.
  2. Vinyl Wallcovering Facing Material: Manufacturer's standard-size unit, not less than 24 inches square.
  3. Panel Edge Material: Not less than 3 inches long.
  4. Hardware: One of each exposed door-operating device.
- E. Delegated-Design Submittal: For operable panel partitions.
1. Include design calculations for seismic restraints that brace tracks to structure above.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Partition track, track supports and bracing, switches, turning space, and storage layout.
  2. Suspended ceiling components.
  3. Structural members to which suspension systems are attached.
  4. Size and location of initial access modules for acoustical tile.
  5. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. HVAC ductwork, outlets, and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Smoke detectors.
- B. Setting Drawings: For embedded items and cutouts required in other work, including support-beam, mounting-hole template.
- C. Qualification Data: For qualified Installer and manufacturer.

- D. Product Certificates: For each type of operable panel partition.
  - 1. Include approval letter signed by manufacturer acknowledging Owner-furnished panel facing material complies with requirements.
- E. Product Test Reports: For each operable panel partition, for tests performed by a qualified testing agency.
- F. Sample Warranty: For manufacturer's special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For operable panel partitions to include in maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Panel finish facings and finishes for exposed trim and accessories. Include precautions for cleaning materials and methods that could be detrimental to finishes and performance.
    - b. Seals, hardware, track, track switches, carriers, and other operating components.
    - c. Electric operator and controls.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Provide an experienced installer, certified by the operable partition manufacturer as qualified to install the manufacturer's partition system for work similar in material, design, and extent to that indicated for this project. Installer shall have a minimum of 5-years' successful experience on projects of similar scope and complexity.
- B. Manufacturer's Qualifications: Manufacturer's shall have a minimum of 5 years in producing type of operable partitions specified of similar type and complexity.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protectively package and sequence panels in order for installation. Clearly mark packages and panels with numbering system used on Shop Drawings. Do not use permanent markings on panels.

#### 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of operable panel partitions that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:

- a. Faulty operation of operable panel partitions.
  - b. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period: Ten years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic bracing of tracks to structure above.
- B. Acoustical Performance: Provide operable panel partitions tested by a qualified testing agency for the following acoustical properties according to test methods indicated:
  1. Sound-Transmission Requirements: Operable panel partition assembly tested for laboratory sound-transmission loss performance according to ASTM E 90, determined by ASTM E 413, and rated for not less than the STC indicated.
  2. Noise-Reduction Requirements: Operable panel partition assembly, identical to partition tested for STC, tested for sound-absorption performance according to ASTM C 423, and rated for not less than the NRC indicated.
  3. Noise-Isolation Requirements: Installed operable panel partition assembly, identical to partition tested for STC, tested for NIC according to ASTM E 336, determined by ASTM E 413, and rated for 10 dB less than STC value indicated.
- C. Fire-Test-Response Characteristics: Provide panels with finishes complying with one of the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  1. Surface-Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  2. Fire Growth Contribution: Complying with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.
- D. Install panel partition system track capable of supporting imposed loads, with a maximum deflection of L/360 of span.

### 2.2 MANUFACTURERS

- A. Provide product lines of the following manufacturer provided they comply with the requirements of the contract documents.

1. BASIS OF DESIGN: "HUFCORE – Series 643E – Electrically Operated Continuously Hinged Train Panel"
2. Panelfold
3. Advanced Equipment Corporation

## 2.3 OPERABLE ACOUSTICAL PARTITIONS

- A. Operable Acoustical Panels: Partition system, including panels, seals, finish facing, suspension system, operators, and accessories.
- B. Panel Operation: Electrically Operated Continuously Hinged, top supported individual panels.
- C. Panel Construction: As required to support panel from suspension components and with reinforcement for hardware attachment. Fabricate panels with tight hairline joints and concealed fasteners. Fabricate panels so finished in-place partition is rigid; level; plumb; aligned, with tight joints and uniform appearance; and free of bow, warp, twist, deformation, and surface and finish irregularities.
- D. Dimensions: Fabricate operable acoustical panel partitions to form an assembled system of dimensions indicated and verified by field measurements.
  1. Panel Width: Standard widths.
- E. STC: Not less than 49 per ASTM E90-85.
- F. NRC: Not less than 0.50
- G. NIC: Not less than 42
- H. Panel Weight: Minimum 8.5 lbs./sq. ft. and maximum 12 lbs./sq. ft.
- I. Panel Thickness: Not less than 4 inches.
- J. Panel Materials:
  1. Steel Frame: Steel sheet, 16 gauge formed steel with overlapped and welded corners for rigidity. Top channel shall be reinforced to support suspension components. Provide internal steel stiffeners as required for backing installation.
  1. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; ASTM B221 for extrusions; manufacturer's standard strengths and thicknesses for type of use.
  2. Steel Face/Liner Sheets: Rolled formed steel wrapping around panel edge, with panel skins lock-formed and welded directly to the frame for unitized construction.
  3. Gypsum Board: Material as required for backing and to achieve specified acoustical ratings, per ASTM C 1396.
  4. Cement Board: ASTM C 1288.
- K. Panel Closure: Manufacturer's standard unless otherwise indicated.

- L. Hardware: Manufacturer's standard as required to operate operable panel partition and accessories; with decorative, protective finish.

## 2.4 SEALS

- A. General: Provide seals that produce operable panel partitions complying with performance requirements and the following:
  - 1. Manufacturer's standard seals unless otherwise indicated.
  - 2. Seals made from materials and in profiles that minimize sound leakage.
  - 3. Seals fitting tight at contact surfaces and sealing continuously between adjacent panels and between operable panel partition perimeter and adjacent surfaces, when operable panel partition is extended and closed.
- B. Vertical Seals: Deep-nesting, interlocking astragals mounted on each edge of panel, with continuous PVC acoustical seal.
- C. Horizontal Top Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on track when extended.
- D. Horizontal Bottom Seals: PVC-faced, mechanical, retractable, constant-force-contact seal exerting uniform constant pressure on floor when extended, ensuring horizontal and vertical sealing and resisting panel movement.
  - 1. Mechanically Operated for Acoustical Panels: Extension and retraction of bottom seal by operating handle or built-in operating mechanism, with operating range not less than 1-1/2 inches between retracted seal and floor finish.

## 2.5 PANEL FINISH FACINGS

- A. General: Provide finish facings for panels that comply with indicated fire-test-response characteristics and that are factory applied to operable panel partitions with appropriate backing, using mildew-resistant non-staining adhesive as recommended by facing manufacturer's written instructions.
  - 1. Apply one-piece, seamless facings free of air bubbles, wrinkles, blisters, and other defects, with edges tightly butted, and with no gaps or overlaps. Tightly secure and conceal raw and selvage edges of facing for finished appearance.
  - 2. Where facings with directional or repeating patterns or directional weave are indicated, mark facing top and attach facing in same direction.
- B. Provide panel finishes as follows:
  - 1. On panels, provide vinyl coated fabric wall covering from the finished floor to 96-inches above finished floor. From 96-inches and above, provide the carpet wall covering. Provide this configuration on both sides of the panel.

- C. Vinyl-Coated Fabric Wall Covering: Manufacturer's standard, mildew-resistant, washable, vinyl-coated fabric wall covering; complying with CFFA-W-101-D for type indicated; Class A.
  - 1. Total Weight: 20 ounces per square yard
  - 2. Antimicrobial Treatment: Additives capable of inhibiting growth of bacteria, fungi, and yeasts.
  - 3. Color/Pattern: As selected by Architect from manufacturer's full range of offerings.
- D. Carpet Wall Covering: Manufacturer's standard non-woven, needle-punched carpet with fibers fused to backing, from same dye lot, treated to resist stains.
  - 1. Color/Pattern: Acousti-rib
- E. Paint: Manufacturer's standard factory painted finish.
  - 1. Color: As selected by Architect from manufacturer's full range
- F. Cap-Trimmed Edges: Protective perimeter-edge trim with tight hairline joints concealing edges of panel and finish facing, finished as follows:
  - 1. Aluminum: Finished with manufacturer's standard clear anodic finish.

## 2.6 SUSPENSION SYSTEMS

- A. Tracks: Aluminum with adjustable steel hanger rods for overhead support, designed for operation, size, and weight of operable panel partition indicated. Size track to support partition operation and storage without damage to suspension system, operable panel partitions, or adjacent construction. Limit track deflection to no more than 1/360 between bracket supports. Provide a continuous system of track sections and accessories to accommodate configuration and layout indicated for partition operation and storage.
  - 1. Panel Guide: Aluminum guide on both sides of the track to facilitate straightening of the panels; finished with factory-applied, decorative, protective finish.
  - 2. Head Closure Trim: As required for acoustical performance; with factory-applied, decorative, protective finish.
- B. Carriers: Trolley system as required for configuration type, size, and weight of partition and for easy operation; with ball-bearing wheels.
  - 1. For each panel, provide four independently replaceable steel wheels and tires with thrust type roller bearings, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.
- C. Track Intersections, Switches, and Accessories: As required for operation, storage, track configuration, and layout indicated for operable panel partitions, and compatible with partition assembly specified. Fabricate track intersections and switches from steel or aluminum.



1. Curve-and-Diverter Switches: Allow radius turns to divert panels to an auxiliary track.
2. Center carrier stop.

- D. Aluminum Finish: Mill finish or manufacturer's standard, factory-applied, decorative finish unless otherwise indicated.

## 2.7 ELECTRIC OPERATORS

- A. Factory-assembled electric operation system of size and capacity recommended and provided by operable panel partition manufacturer for partition specified; with electric motor and factory-prewired motor controls, speed reducer, chain drive, control stations, control devices, and accessories required for operation. Include wiring from control stations to motor. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
- B. Comply with NFPA 70.
- C. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.
- D. Motor Electrical Characteristics:
1. Horsepower: Manufacturer's standard
  2. Volts: 208
  3. Phase: Single phase
  4. Hertz: 60.
- E. Control Stations: Two single-key-operated, constant-pressure control stations located remotely from each other on opposite sides and opposite ends of partition run. Wire in series to require simultaneous activation of both key stations to operate partition. Each three-position control station labeled "Open," "Close," and "Stop." Furnish two keys per station.
- F. Obstruction-Detection Devices: Equip each motorized operable panel partition with indicated automatic safety sensor that causes operator to immediately stop and reverse direction.
1. Sensor Edge: Contact-pressure-sensitive safety edge along partition's leading edge.
  2. Sensor Mat: Electrically operated, contact-weight-sensitive safety mat in storage pocket area.
  3. Infrared Sensor System: Designed to detect an obstruction in partition's path and sound an audible alarm, without obstruction contacting partition.
- G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop operable panel partition at fully extended and fully stacked positions.
- H. Emergency Release Mechanism: Quick disconnect-release of electric-motor drive system, permitting manual operation in event of operating failure.
- I. Electric Interlock: Equip each motorized operable panel partition with electric interlocks at locations indicated, to prevent operation of operable panel partition under the following conditions:

1. On storage pocket door, to prevent operation if door is not in fully open position.
2. On partitions at location of convergence by another partition, to prevent operation if merging partitions are in place.

## 2.8 ACCESSORIES

- A. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware and acoustical seals at soffit, floor, and jambs. Hinges in finish to match other exposed hardware.
  1. Manufacturer's standard method to secure storage pocket door in closed position.
  2. Rim Lock: Deadlock to receive cylinder, to secure storage pocket door in closed position. Provide two keys per lock.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable panel partitions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Comply with ASTM E 557 except as otherwise required by operable panel partition manufacturer's written installation instructions.
- B. Install operable panel partitions and accessories after other finishing operations, including painting, have been completed in area of partition installation.
- C. Install panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.
- E. Light-Leakage Test: Illuminate one side of partition installation and observe vertical joints and top and bottom seals for voids. Adjust partitions for alignment and full closure of vertical joints and full closure along top and bottom seals.

### 3.3 ADJUSTING

- A. Adjust operable panel partitions, hardware, and other moving parts to function smoothly, and lubricate as recommended by manufacturer.

- B. Adjust storage pocket doors to operate smoothly and easily, without binding or warping.

#### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain operable panel partitions.

END OF SECTION 102236

## SECTION 102600 - WALL AND DOOR PROTECTION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Corner guards (CG1).
  - 2. Abuse-resistant wall coverings (ARWC1, ARWC2, & ARWC3)

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
- C. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.
  - 1. Include Samples of accent strips and accessories to verify color selection.
- D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
  - 1. Corner Guards: 12 inches long. Include example top caps.
  - 2. Abuse-Resistant Wall Covering: 6 by 6 inches square.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
  - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two units.
  - 2. Mounting and Accessory Components: Amounts proportional to the quantities of extra materials. Package mounting and accessory components with each extra material.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
  - 2. Keep plastic materials out of direct sunlight.
  - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
    - a. Store corner-guard covers in a vertical position.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    - b. Deterioration of materials beyond normal use.
  - 2. Warranty Period: Ten years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
  2. Smoke-Developed Index: 450 or less.

## 2.3 CORNER GUARDS CG1

- A. Surface-Mounted, Opaque-Plastic Corner Guards Fabricated as one piece from PVC-free plastic with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. InPro
    - b. C/S Group
    - c. Koroseal
    - d. Construction Specialties
  2. Wing Size: As indicated on drawings.
  3. Mounting: Adhesive.
  4. Color and Texture: As indicated on drawings.

## 2.4 ABUSE-RESISTANT WALL COVERINGS ARWC1, ARWC2, & ARWC3

- A. Abuse-Resistant Sheet Wall Covering ARWC1 and ARWC2: Fabricated from semirigid, plastic sheet wall-covering material.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product as approved by interior designer of record.
    - a. Altro
    - b. InPro
    - c. Construction Specialties
  2. Size: 48 by 118 inches.
  3. Sheet Thickness: 2.5 mm.
  4. Color and Texture: As indicated on drawings.
  5. Height: As indicated on drawings.
  6. Trim and Joint Moldings: Manufacturer's standard extruded rigid plastic that matches wall-covering color.
  7. Mounting: In accordance with manufacturer's instructions.
- B. Abuse-Resistant Sheet Wall Covering ARWC3: stainless steel sheet.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. InPro
  - b. C/S Group
  - c. Koroseal
2. Size: 48 by 96 inches
3. Sheet Thickness: 18 gauge.
4. Color and Texture: As indicated on drawings.
5. Height: As indicated on drawings.
6. Trim and Joint Moldings: manufacturer's standard to match panel.
7. Mounting: Adhesive.

## 2.5 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- C. Adhesive: As recommended by protection product manufacturer.

## 2.6 FABRICATION

- A. Fabricate wall protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.
- C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

## 2.7 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine walls to which wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  - 1. For wall protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

#### 3.3 INSTALLATION

- A. Installation Quality: Install wall protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
  - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
  - 2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
  - 3. Adjust end and top caps as required to ensure tight seams.
- D. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.



3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Public-use washroom accessories.
  - 2. Public-use shower room accessories.
  - 3. Hand dryers.
  - 4. Childcare accessories.
  - 5. Underlavatory guards.
  - 6. Custodial accessories.

- B. Related Requirements:

- 1. Section 088300 "Mirrors" for frameless mirrors.

#### 1.3 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.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
  - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
  - 3. Include electrical characteristics.

- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

- 1. Identify locations using room designations indicated.
  - 2. Identify accessories using designations indicated.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

## 1.7 WARRANTY

- A. Manufacturer's Special Warranty for Hand Dryers: Manufacturer agrees to repair or replace hand dryers that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: Five years from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Structural Performance: Design accessories and fasteners to comply with the following requirements:
  - 1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
  - 2. Shower Seats: Installed units are able to resist 250 lbf applied in any direction and at any point.

### 2.2 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain each type of public-use washroom accessory from single source from single manufacturer.
- B. Combination Towel (Folded) Dispenser/Waste Receptacle (B1):

1. Basis-of-Design Product: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle. Provide Bobrick B-3944 or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  2. Mounting: Recessed with projecting receptacle
  3. Designed for nominal 4-inch wall depth.
  4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
  5. Minimum Waste-Receptacle Capacity: 12 gal..
  6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
  7. Liner: Reusable, vinyl waste-receptacle liner.
  8. Lockset: Tumbler type for towel-dispenser compartment.
- C. Toilet Tissue (Roll) Dispenser (H1):
1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-2888 or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  2. Description: Double-roll dispenser.
  3. Mounting: Surface mounted.
  4. Operation: Eccentric-shaped, molded-plastic spindle revolves one-half revolution per dispensing operation for controlled delivery; core cannot be removed until roll is empty.
  5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
  6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- D. Automatic Counter Mounted Soap Dispenser (C1):
1. Manufacturers: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. B-828 or a comparable product by one of the following:
    - a. AJW Architectural Products.
    - b. American Specialties, Inc.
  2. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing soap in liquid or lotion form.
  3. Mounting: Surface mounted.
  4. Capacity: 30 oz.
  5. Materials: Stainless Steel.
  6. Low-Battery Indicator: LED indicator.
- E. Automatic Surface Mounted Soap Dispenser (C2):
1. Manufacturers: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc. Model B-2012 or a comparable product by one of the following:
    - a. AJW Architectural Products.

- b. American Specialties, Inc.
  - 2. Description: Automatic dispenser with infrared sensor to detect presence of hands; battery powered; designed for dispensing soap in liquid or lotion form.
  - 3. Mounting: Surface mounted.
  - 4. Capacity: 30 oz.
  - 5. Materials: Stainless Steel.
  - 6. Low-Battery Indicator: LED indicator.
- F. Grab Bar (R1; R2; R3):
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-5806 or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  - 2. Mounting: Flanges with concealed fasteners.
  - 3. Material: Stainless steel, 0.05 inch thick.
    - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
  - 4. Outside Diameter: 1-1/4 inches.
  - 5. Configuration and Length: As indicated on Drawings.
- G. Grab Bar (R4):
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-58616 (verify size with shower compartment) or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  - 2. Mounting: Flanges with concealed fasteners.
  - 3. Material: Stainless steel, 0.05 inch thick.
    - a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.
  - 4. Outside Diameter: 1-1/4 inches.
  - 5. Configuration and Length: As indicated on Drawings.
- H. Sanitary-Napkin Disposal Unit (J1):
- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-254 or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.

- b. American Specialties, Inc.
- 2. Mounting: Surface mounted.
  - 3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
  - 4. Receptacle: Removable.
  - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- I. Seat-Cover Dispenser (L1):
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-221 or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  - 2. Mounting: Surface mounted.
  - 3. Minimum Capacity: 250 seat covers.
  - 4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin) .
  - 5. Lockset: Tumbler type.
- J. Purse Shelf (F2):
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-287 or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  - 2. Description: Hinged unit with spring-loaded shelf that automatically returns to vertical position.
  - 3. Nominal Size: 15 inches long by 5-1/2 inches wide.
  - 4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- K. Mirror Unit (A1):
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc B-290 1830 or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  - 2. Frame: Stainless-steel channel.
    - a. Corners: Manufacturer's standard.
  - 3. Hangers: Manufacturer's standard.
  - 4. Size: As indicated on Drawings.

A. Source Limitations: Obtain each type of public-use shower room accessory from single source from single manufacturer.

B. Shower Curtain Rod (M1):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-207 or comparable product by one of the following:

- a. A&J Washroom Accessories, Inc.
- b. American Specialties, Inc.

- 2. Description: 1-inch- outside diameter, straight rod.
- 3. Configuration: As indicated on Drawings
- 4. Mounting Flanges: Concealed fasteners; Stainless steel.
- 5. Rod Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Folding Shower Seat (T1):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-5181 or comparable product by one of the following:

- a. A&J Washroom Accessories, Inc.
- b. American Specialties, Inc.

- 2. Configuration: L-shaped seat, designed for wheelchair access .
- 3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
- 4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
- 5. Dimensions: as indicated.

D. Robe Hook (P1):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-76727 or comparable product by one of the following:

- a. A&J Washroom Accessories, Inc.
- b. American Specialties, Inc.

- 2. Description: Double-prong unit.
- 3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

## 2.4 HAND DRYERS

A. Source Limitations: Obtain hand dryers from single source from single manufacturer.

B. High-Speed Air Dryer (D1):

1. Manufacturers: Subject to compliance with requirements, provide Dyson Airblade V or comparable products by one of the following:

- a. Excel Dryer Inc.
  - b. World Dryer Corporation.
2. Description: High-speed, unheated-air hand dryer for rapid hand drying.
3. Mounting: Surface mounted or semi-recessed mounted as required.
  - a. Protrusion Limit: Installed unit protrudes maximum 4 inches from wall surface.
4. Operation: Infrared-sensor activated with timed power cut-off switch.
  - a. Average Dry Time: 12 seconds.
  - b. Automatic Shut Off: At 60 seconds.
5. Maximum Sound Level: 75 dB.
6. Cover Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
7. Electrical Requirements: 115 V with amperage and wattage as required by the Manufacturer.

## 2.5 CHILDCARE ACCESSORIES

- A. Source Limitations: Obtain childcare accessories from single source from single manufacturer.
- B. Diaper-Changing Station (G1):
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Koala Kare Model KB-110-SSWM or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
    - a. Engineered to support minimum of 250-lb static load when opened.
  3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
  4. Operation: By pneumatic shock-absorbing mechanism.
  5. Material and Finish: Stainless steel, No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners.



6. Liner Dispenser: Built in.

## 2.6 CUSTODIAL ACCESSORIES

- A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.
- B. Custodial Mop and Broom Holder (E1):
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc Model B-239X34 or comparable product by one of the following:
    - a. A&J Washroom Accessories, Inc.
    - b. American Specialties, Inc.
  2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
  3. Length: 36 inches.
  4. Hooks: Four.
  5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
  6. Material and Finish: Stainless steel, No. 4 finish (satin).
    - a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
    - b. Rod: Approximately 1/4-inch- diameter stainless steel.

## 2.7 MATERIALS

- A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch- minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch- minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.
- F. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

## 2.8 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
  - 1. Remove temporary labels and protective coatings.
- B. Grab Bars: Install to comply with specified structural-performance requirements.
- C. Shower Seats: Install to comply with specified structural-performance requirements.

#### 3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800



## SECTION 104413 - FIRE PROTECTION CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes fire-protection cabinets for portable fire extinguishers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

#### 2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Guardian Fire Equipment, Inc.
    - b. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - c. Larsens Manufacturing Company.

- B. Cabinet Construction: 1-hour fire rated as required by wall rating.
  - 1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Stainless-steel sheet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
  - 1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
- E. Cabinet Trim Material: Stainless-steel sheet.
- F. Door Material: Stainless-steel sheet.
- G. Door Style: Vertical duo panel with frame.
- H. Door Glazing: Acrylic sheet.
  - 1. Acrylic Sheet Color: Clear transparent acrylic sheet.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Accessories:
  - 1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
  - 2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.
    - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
      - 1) Location: Applied to cabinet door.
      - 2) Application Process: Silk-screened.
      - 3) Lettering Color: Red.
      - 4) Orientation: Vertical.
- K. Materials:
  - 1. Stainless Steel: ASTM A 666, Type 304.
    - a. Finish: white powdercoat finish, typ. and No. 4 directional satin finish as noted on drawings.

2. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

## 2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations indicated or, if not indicated. Handle heights are to be a maximum of 40" AFF.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413



## SECTION 104416 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.
- B. Related Requirements:
  - 1. Section 104413 "Fire Protection Cabinets."
  - 2. Section 28462.11 "Addressable Fire-Alarm Systems" for coordination with extinguisher monitoring devices. (Alternate No. 33)

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

#### 1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function and to coordinate the installation of the Monitoring Devices.
- B. Coordinate the installation of the Extinguisher Monitoring Devices with fire alarm system installation.



## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure of hydrostatic test according to NFPA 10.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty Period: Six years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  - 1. Provide fire extinguishers approved, listed, and labeled by FM Global.

### 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each indicated.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Amerex Corporation.
    - b. Guardian Fire Equipment, Inc.
    - c. Larsens Manufacturing Company.
  - 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
  - 3. Valves: Manufacturer's standard.
  - 4. Handles and Levers: Manufacturer's standard.
  - 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

- C. Dry-Powder Type: FM approved, UL-rated Class D, 30-lb nominal capacity, with sodium chloride-based powder in enameled-steel container; with pressure-indicating gage.

## 2.3 FIRE EXTINGUISHER MONITORS:

- A. Provide en-Gauge Technology Fire Extinguisher Monitors at each fire extinguisher installation (<http://www.engageinc.net/fire-extinguisher-monitoring>). System includes:
  - 1. Smart Pressure Gauge installed on each extinguisher within extinguisher cabinet. The gauge will notify a central monitoring station when pressure drops below 25%.
  - 2. Provide a Trip Tether in each cabinet. Removal of the extinguisher trips a switch sending an alarm signal to a central monitoring station.
  - 3. Provide an obstruction monitor at each cabinet monitoring the existence of a prolonged obstruction placed in front of the cabinet ensuring compliance with ADA.
- B. Integrate en-Gauge sensors with the building fire alarm system for reporting to the central monitoring station.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION 104416



## SECTION 105129 - PHENOLIC LOCKERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Phenolic Storage Cubbies (LK1)

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
  - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings:

1. Plans, elevations, sections, and attachment details.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of phenolic locker. Include full range of available options for hardware and accessories involving material, finish, and/or color selection.

D. Samples for Verification: Actual sample of finished products for each type of phenolic locker, hardware, and accessory.

1. Size: Manufacturers' standard size.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For phenolic panel, by a qualified testing agency.

B. Qualification Statements: For Installer.

C. Sample Warranties: For phenolic lockers.

#### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For phenolic lockers including adjusting, repairing, and replacing locker doors and latching mechanisms.

## 1.5 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
  - 1. Build mockup of typical cubbie.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Completion.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for their installation.

## 1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with lockers by field measurements, and coordinate before fabrication.

## 1.8 COORDINATION

- A. Coordinate sizes and locations of concealed wood support bases.
  - 1. Requirements are specified in Section 061000 "Rough Carpentry."
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Deterioration of finishes and materials beyond normal use.
  - 2. Warranty Period: 20-year warranty against defects in material and 2 years against workmanship.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain phenolic cubbies from single source from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Accessibility Regulations: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 lockers designated as accessible.

### 2.3 PHENOLIC CUBBIES (LK1)

- 1. Basis of Design product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
  - a. PSiSC – Columbia Lockers
  - b. Spectrum Lockers
  - c. ASI
- B. Construction Style: Manufacturer's standard factory-assembled flush overlay units.
- C. Cubbies: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with beveled and polished edges.
  - a. Fire resistance: Core meets Underwriters Laboratories (UL) Class A fire resistance per ASTM E 84.
- 2. Thickness:
  - a. Top, Bottom, & Shelves: 3/8 inch.
  - b. Sides & Back: 5/16 inch.
- D. Continuous Finish Base: Match style, material, construction, thickness, and finish of doors; fabricated in lengths as long as practical to enclose base and base ends of lockers.
- E. Phenolic Locker Finish:
  - 1. Through-Color Phenolic:
    - a. Color: As indicated on drawings.

## 2.4 ACCESSORIES

### A. Number Identification:

1. Manufacturer's standard.

## 2.5 MATERIALS

- ### A. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

## 2.6 FABRICATION

- ### A. Fabricate to dimensions, profiles, and details indicated.
- ### B. Fabricate cubbies square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.
- ### C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
1. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- ### A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- ### B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.
- ### C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- ### A. Install wood support base with 1/2-inch- (13-mm-) thick, plywood top.
- ### B. Install cubbies level, plumb, and true; shim as required, using concealed shims.

1. Connect single rows of cubbies together side-to-side at each cubbie. Use manufacturer's standard connecting bolts, through predrilled holes, with no exposed fasteners on face frames. Fit accurately together to form flush, tight, hairline joints.
2. Anchor runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c., using manufacturer's standard concealed fasteners for material indicated.
  - a. Anchor single rows of cubbies to walls near top and bottom of cubbies and to wood support base.
- C. Installation Tolerance: No more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line. Shim as required with concealed shims.
- D. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.
- E. Install number identification plates after cubbies are in place.
  1. Attach number identification plate on each cubbie near top, centered, with at least two screws with finish matching the plate.

### 3.3 PROTECTION

- A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105123





## SECTION 113013 - RESIDENTIAL APPLIANCES (NOT IN CONTRACT)

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Cooking appliances.
  - 2. Refrigeration appliances.

- B. Related Requirements:

- 1. Section 113200 "Unit Kitchens" for small, compact kitchen units that include residential appliances.
  - 2. Section 224100 "Residential Plumbing Fixtures" for kitchen sinks, dishwasher air-gap fittings, waste (garbage) disposers, and instant hot-water dispensers.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

- B. Product Schedule: For appliances. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Product Certificates: For each type of appliance.

- C. Field quality-control reports.
- D. Sample Warranties: For manufacturers' special warranties.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintains, within <Insert number> miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

## 1.8 WARRANTY

- A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Final Acceptance.
- B. Microwave Oven: Limited warranty, including parts and labor for first year and parts thereafter for on-site service
  - 1. Warranty Period: Five years from date of Final Acceptance.
- C. Refrigerator/Freezer Sealed System: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service on the product.
  - 1. Warranty Period for Sealed Refrigeration System: Five years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain residential appliances from single source.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- B. Gas-Fueled Appliances: Certified by a qualified testing agency for each type of gas-fueled appliance according to ANSI Z21 Series standards.
- C. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design, the ABA standards of the Federal agency having jurisdiction and ICC A117.1

## 2.3 MICROWAVE OVENS

### A. Microwave Oven MO:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Bosch US; BSH Home Appliances Corporation.
  - b. Frigidaire.
  - c. GE Appliances; Haier Group.
  - d. Jennair; Whirlpool Corporation.
  - e. Kenmore; Transformco SR Brands LLC.
  - f. KitchenAid; Whirlpool Corporation.
  - g. LG Electronics USA, Inc.; LG Electronics Inc.
  - h. Maytag; Whirlpool Corporation.
  - i. Samsung Electronics America, Inc. (SEA); Samsung Electronics Co., Ltd. (SEC).
- 2. Mounting: Undercabinet.
- 3. Type: Conventional.
- 4. Dimensions:
  - a. Width: As indicated on Drawings
  - b. Depth: As indicated on Drawings
  - c. Height: As indicated on Drawings
- 5. Capacity: 1.5 cu. Ft.
- 6. Oven Door: Door with observation window
- 7. Exhaust Fan: Two speed fan, nonvented, and with manufacturer's standard capacity.
- 8. Microwave Power Rating: 1000 W.
  - a. Convection Element Power Rating: Manufacturer's standard
- 9. Electric Power Supply: As indicated on Drawings
- 10. Controls: Digital panel controls and timer display.
- 11. Other Features: Turntable
- 12. Material: Manufacturer's standard.
  - a. Color/Finish: stainless.

## 2.4 REFRIGERATOR/FREEZERS RF

### A. Refrigerator/Freezer RF Two-door, side-by-side refrigerator/freezer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Samsung Electronics America, Inc. (SEA);. (Basis of Design)
  - b. Frigidaire.
  - c. LG Electronics USA, Inc.; LG Electronics Inc.
  - d. Bosch US; BSH Home Appliances Corporation.
  - e. GE Appliances; Haier Group.
  - f. Jennair; Whirlpool Corporation.
  - g. Kenmore; Transformco SR Brands LLC.
  - h. KitchenAid; Whirlpool Corporation.
  - i. Whirlpool Corporation.
2. Type: Freestanding.
3. Dimensions:
  - a. Width: 36"
  - b. Depth: 24" counter depth
  - c. Height: 70"
4. Storage Capacity:
  - a. Refrigeration Compartment Volume: 14.6 cu. ft.
  - b. Freezer Volume: 8 cu. ft.
  - c. Shelf Area: Three adjustable glass shelves.
5. General Features:
  - a. Door Configuration:
  - b. Dispenser in door for ice and cold water.
  - c. Built-in water-filtration system.
  - d. Dual refrigeration systems.
6. Refrigerator Features:
  - a. Interior light in refrigeration compartment.
  - b. Compartment Storage: .
  - c. Door Storage: Modular compartments.
7. Freezer Features: One freezer compartment(s) with door(s) configured as pull-out drawer.
  - a. Automatic defrost.
  - b. Interior light in freezer compartment.
  - c. Automatic icemaker and storage bin.

8. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
9. Front Panel(s): manufacturer standard
10. Appliance Color/Finish: stainless

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. Examine walls, ceilings, and roofs for suitable conditions where products will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Range Anti-Tip Device: Install at each range according to manufacturer's written instructions.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances.

END OF SECTION 113013

## SECTION 122413 – MANUAL WINDOW ROLLER SHADES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Roller shades for manual operation and accessories for RWS1.
  - 2. Shade fabric for RWS1.

- B. Related Requirements:

- 1. Section 092116.23 “Gypsum Board Shaft Wall Assemblies” Coordination with gypsum board assemblies for installation of shade pockets, closures and related accessories.
  - 2. Section 095113 “Acoustical Panel Ceilings” Coordination with acoustical ceiling systems for installation of shade pockets, closures and related accessories.

#### 1.3 REFERENCES

- A. ASTM International (ASTM):

- 1. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

- B. Cradle to Cradle Products Innovation Institute (C2C):

- 1. C2C (DIR) - C2C Certified Products Registry.

- C. National Fire Protection Association (NFPA):

- 1. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
  - 2. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

- D. Underwriters Laboratories (UL):

- 1. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

- E. Window Covering Manufacturers Association (WCMA):



1. WCMA A 100.1 - Safety of Window Covering Products; 2018.

#### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: One week prior to commencing work related to this section. Require attendance of all affected installers.
- B. Sequencing:
  1. Do not fabricate shades until field dimensions for each opening have been taken with finished conditions in place. "Hold to" dimensions are not acceptable.
  2. Do not install shades until final surface finishes and painting are complete.

#### 1.5 SUBMITTALS

- A. See Section 013000 "Submittal Procedures."
- B. Product Data: Manufacturer's catalog pages and data sheets for products specified including materials, finishes, dimensions, profiles, mountings, and accessories.
  1. Preparation instructions and recommendations.
  2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes, accessories, and operating instructions.
  3. Storage and handling requirements and recommendations.
  4. Mounting details and installation methods.
  5. Manufacturer's Instructions: Include storage, handling, protection, examination, preparation, and installation.
  6. Operation and Maintenance Data: Component list with part numbers, and operation and maintenance instructions.
- C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances and relationship to adjacent work.
  1. Prepare shop drawings on AutoCad or Revit format using base sheets provided electronically by the Architect.
- D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- E. Verification Samples: For each finish product specified, one complete set of shade components, unassembled, demonstrating compliance with specified requirements.
  1. Shadecloth Sample: Mark face of material to indicate interior faces.
    - a. Test reports indicating compliance with specified fabric properties.
    - b. Verification Samples: 6 inches square, representing actual materials, color and pattern.

- F. Maintenance Data: Bill of materials for all components with part numbers. Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware.
- G. Warranty: Provide manufacturer's warranty documents as specified in this Section.

#### 1.6 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- B. Manufacturer Qualifications: Obtain roller shades system through one source from a single manufacturer with a minimum of ten years experience and minimum of five projects of similar scope and size in manufacturing products comparable to those specified in this section.
- C. Installer for Roller Shade System - Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- D. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- E. Shadecloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC9644, ATCC9645.
- F. Environmental Certification: Submit written certification from the manufacturer, including third party evaluation, recycling characteristics, and perpetual use certification as specified. Initial submittals, which do not include the Environmental Certification will be rejected. Materials that are simply 'PVC free' without identifying their inputs shall not qualify as meeting the intent of this specification and shall be rejected.
- G. Third Party Evaluation: Provide documentation stating the shade cloth has undergone third party evaluation for all chemical inputs, down to a scale of 100 parts per million, that have been evaluated for human and environmental safety. Identify any and all inputs, which are known to be carcinogenic, mutagenic, teratogenic, reproductively toxic, or endocrine disrupting. Also identify items that are toxic to aquatic systems, contain heavy metals, or organohalogens. The material shall contain no inputs that are known problems to human or environmental health per the above major criteria, except for an input that is required to meet local fire codes.
- H. Recycling Characteristics: Provide documentation that the shade cloth can and is part of a closed loop of perpetual use and not be required to be down cycled, incinerated or otherwise thrown away. Scrap material can be sent back to the mill for reprocessing and recycling into the same quality yarn and woven into new material, without down cycling. Certify that this process is currently underway and will be utilized for this project.
- I. Perpetual Use Certification: Certify that at the end of the useful life of the shade cloth, that the material can be sent back to the manufacturer for recapture as part of a closed loop of perpetual

use and that the material can and will be reconstituted into new yarn, for weaving into new shade cloth. Provide information on each shade band indicating that the shade band can be sent back to the manufacturer for this purpose.

#### 1.7 MOCK-UP

- A. Provide a mock-up of one roller shade assembly for evaluation of mounting, appearance and accessories.
  - 1. Locate mock-up in window designated by Architect.
  - 2. Mockup Size: Full size.
  - 3. Mockup Size (WxH): 3 x 3 feet minimum.
  - 4. Intent of mock-up is to demonstrate quality of workmanship and visual appearance.
  - 5. If mock-up is not acceptable, rebuild mock-up until satisfactory results are achieved.
  - 6. Do not proceed with remaining work until, mock-up is accepted by Architect.
  - 7. Retain mock-up during construction as a standard for comparison with completed work.
  - 8. Do not alter or remove mock-up until work is completed or removal is authorized.
  - 9. Full-sized mock-up may become part of the final installation.
  - 10. Full-sized mock-up will become the property of the Owner to be used for spare parts if not utilized in final installation.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in factory-labeled packages, marked with manufacturer and product name, fire-test response characteristics, and location of installation using same room designations indicated on Drawings and in Window Treatment Schedule.
- B. Store and handle products per manufacturer's recommendations.

#### 1.9 WARRANTY

- A. Roller Shade Hardware and Chain Warranty: Manufacturer's standard non-depreciating warranty for interior shading.
  - 1. Shade Hardware: Manufacturer's standard 10 year warranty.
  - 2. Shadecloth: Manufacturer's standard 10 year warranty.
  - 3. Roller Shade Installation: One year from date of Final Acceptance, not including scaffolding, lifts or other means to reach inaccessible areas, which are deemed owner's responsibility.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following, or approved equal:
  - 1. MechoShade Systems, LLC.
  - 2. Draper Inc.
  - 3. Spring Window Fashions.
- B. Requests for substitutions for an approved equal will be considered in accordance with provisions of Section 016000 "Product Requirements" and Section 012500 "Substitution Procedures."

### 2.2 ROLLER SHADES, MANUAL OPERATION AND ACCESSORIES (RWS1)

- A. Shade System; General:
  - 1. Components capable of being removed or adjusted without removing mounted shade brackets, or cassette support channel.
  - 2. Smooth operation raising or lowering shades.
  - 3. Cradle-to-Cradle certified for the complete shade system including operating hardware and shadecloth. Listed in C2C (DIR).
- B. Basis of Design: As indicated on drawings. Fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
  - 1. Shade Type: Single roller.
  - 2. Drop Position: Regular. Fabric falls off roller tube, close to glass.
  - 3. Mounting: Window jamb mounted.
  - 4. Size: As indicated on drawings.
  - 5. Fabric: As indicated on drawings.
  - 6. Brackets and Mounting Hardware: Stamped steel. As recommended by manufacturer for mounting indicated accommodating shade fabric roll-up size and weight.
  - 7. Roller Tubes: Extruded aluminum. Capable of being removed and reinstalled without affecting roller shade limit adjustments.
    - a. Size: As recommended by manufacturer; for installation conditions, span, and weight of shades.
    - b. Fabric Attachment: Extruded channel in tube accepts vinyl spline welded to fabric edge.
      - 1) Shade Band: Removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
  - 8. Hembars: Maintains bottom of shade straight and flat.

- a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
- 9. Manual Operation:
  - a. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
  - b. Drive Chain: Continuous loop beaded ball chain. Upper and lower limit stops.
    - 1) Breaking Force: 45 lbf minimum.
    - 2) Chain Retainer per WCMA A100.1: Tensioning device.
  - c. Lift Assist Mechanism: Contained in idler end of roller tube. When hanging weights exceed roller tube weight limits. Manufacturer's standard.
- 10. Accessories:
  - a. Fascia: Removable extruded aluminum. Size as required to conceal shade mounting. Attachable to brackets without exposed fasteners.
    - 1) Finish: Baked enamel.
      - a) Color: To be determined by interior designer of record from manufacturer's full offering.
    - 2) Profile: Square.
    - 3) Configuration: Continuous, fascia extends past continuous bracket.

## 2.3 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
  - 1. Vertical Dimensions: Fill Opening from Head to Sill: 1/2-inch space between bottom bar and window stool.
  - 2. Horizontal Dimensions: Inside Mounting.
    - a. Fill openings from jamb to jamb. No light gap.
- C. Openings Requiring Continuous Multiple Shade Units with Separate Rollers: Locate roller joints at window mullion centers; butt rollers end-to-end.

## 2.4 SHADE FABRIC

- A. Basis of Design: Shade fabric as manufactured by Mecho.
  - 1. Solar Shadecloth used in RWS1:

- a. Fabric: As indicated on drawings.
  - b. Flammability per NFPA 701-2015: Pass.
  - c. Fungal Resistance: No growth when tested per ASTM G21.
  - d. Solar Transmittance: 7%, nominal.
  - e. Visible Light Transmittance: 12% nominal.
  - f. Solar Absorption: 39% nominal.
  - g. Solar Reflectance: 54% nominal.
  - h. Acoustic Performance: 0.65 NRC.
  - i. Mesh Weight: 14.51 oz/yd.
  - j. Fabric thickness: 0.0358 in.
  - k. Openness Factor: As indicated on drawings.
  - l. Color: As indicated on drawings
2. Fabric Properties: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
  - a. Shade: Light filtering
    - 1) Material Composition: 100 percent TPO coated polyolefin yarn.
3. Fabrication:
  - a. Fabric Orientation: As recommended by Manufacturer.
  - b. Battens: Manufacturer's standard material, full width of shade, and enclosed in welded shade fabric pocket.
  - c. Seams for Railroaded Fabric: Manufacturer's standard sewn seam.

### PART 3 - EXECUTION

#### 3.1 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. Start of installation shall be considered acceptance of substrates.

#### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

- C. Coordinate with window installation and placement of concealed blocking to support shades.

### 3.3 INSTALLATION

- A. Install shades level, plumb, square, and true per manufacturer's instructions and approved shop drawings. Locate so shade band is at least 2 inches (51 mm) from interior face of glass. Allow proper clearances for window operation hardware. Use mounting devices as indicated.
- B. Replace shades exceeding specified tolerances at no extra cost to Owner.
- C. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric.
- D. Clean roller shade surfaces after installation, per manufacturer's written instructions.
- E. Demonstrate operation and maintenance of window shade system to Owner's personnel.
- F. Manufacturer's authorized personnel are to train Owner's personnel on operation and maintenance of system.
  - 1. Provide and use operation and maintenance manual as a reference, supplemented with additional training materials as required.

### 3.4 PROTECTION AND CLEANING

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Final Acceptance.
  - 1. Clean soiled shades and exposed components as recommended by manufacturer.
  - 2. Replace shades that cannot be cleaned to "like new" condition.

END OF SECTION 122413

## SECTION 123661.16 - SOLID SURFACING COUNTERTOPS AND FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes: (SSM1, SSM2, & SSM3)

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface material apron fronts.
5. Solid surface shower units.
6. Solid surface windowsills.

B. Related Requirements:

1. Section 224216.13 "Commercial Lavatories" for non-integral sinks and plumbing fittings.
2. Section 224216.16 "Commercial Sinks" for non-integral sinks and plumbing fittings.

C. Product Data: For countertop, shower unit, and windowsill materials.

D. Shop Drawings: For countertop, shower unit, windowsills and sinks. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.
3. Show locations of any penetrating utilities.

E. Samples for Initial Selection: For each type of material exposed to view.

F. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. Shower unit material, 6 inches square.
3. Windowsill material, 6 inches square.
4. Sink material, 6 inches square.

#### 1.2 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.



### 1.3 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
  - 1. Build mockup of typical countertop and windowsill as indicated on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Final Acceptance.

### 1.4 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

### 1.5 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

## PART 2 - PRODUCTS

### 2.1 SOLID SURFACE COUNTERTOP MATERIALS (SSM1 & SSM2)

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ISFA 2-01.
  - 1. Basis of Design product: Subject to compliance with requirements, for countertops, windowsills and sinks provide product indicated on drawings or comparable product from one of the following:
    - a. Formica
    - b. Avonite Surfaces.
    - c. E. I. du Pont de Nemours and Company.
    - d. Wilsonart International Holdings, Inc.
  - 2. Shower unit to be manufacturer's standard solid surface as indicated on drawings or comparable unit/system from one of the following:
    - a. InPro Endurant
    - b. Tower Industries
    - c. Comfort Designs

3. Type: Provide Standard type unless Special Purpose type is indicated.
4. Integral Sink Bowls: Comply with CSA B45.5/IAPMO Z124.
5. Colors and Patterns: As indicated on drawings.

B. Particleboard: ANSI A208.1, Grade M-2.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

## 2.2 FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WT's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top and bottom and as indicated on drawings.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops:

1. 1/2-inch- thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2-inch- thick, solid surface material.

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints:

1. Fabricate countertops in sections for joining in field.
  - a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
  - b. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

- a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
2. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

## 2.3 SOLID-SURFACE-MATERIAL SHOWER UNIT

- A. Basis of Design product: Subject to compliance with requirements, provide product indicated on drawings or comparable commercial grade product from one of the following:
  1. InPro Endurant
  2. Tower Industries
  3. Comfort Designs
- B. Configuration: As indicated on drawings
- C. Fabrication: Comply with shower manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

## 2.4 SOLID-SURFACE-MATERIAL WINDOWSILLS (SSM3)

- A. Configuration: Provide window sills with the following front style:
  1. Front: 1/2-inch thick with eased edge.
- B. Window Sills: 1/2-inch- thick, solid surface material.
- C. Fabrication: Fabricate window sills in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

## 2.5 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants." For sealants of joints in locations anticipated for food contact and preparation, provide NSF/ANSI Standard 51 compliant food grade sealant at kitchen.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates to receive solid surface material items and conditions under which solid surface items will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of solid surface items.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install countertops and windowsills level to a tolerance of 1/8 inch in 8 feet , 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop or windowsill as applicable, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
  - 1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
  - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- E. Install windowsills, backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

END OF SECTION 123661.16

## SECTION 142123 - MACHINE-ROOM-LESS HYDRAULIC PASSENGER ELEVATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes machine-room-less hydraulic passenger / service elevator.
- B. Related Requirements:
  - 1. Section 033000 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
  - 2. Section 051200 "Structural Steel Framing" for the following:
    - a. Divider beams.
    - b. Hoist beams.
  - 3. Section 055000 "Metal Fabrications" for the following:
    - a. Attachment plates and angle brackets for supporting guide-rail brackets.
    - b. Sump covers.
    - c. Structural-steel shapes for subsills.
    - d. Pit ladders.
    - e. Cants made from steel sheet in hoistways.
  - 4. Section for finish flooring in elevator cars.
  - 5. Section 221429 "Sump Pumps" for sump pumps in elevator pits.
  - 6. Section 271513 "Communications Copper Horizontal Cabling" for twisted pair cable for telephone service for elevators and for connection to elevator controllers for remote monitoring of elevator performance.
  - 7. Section 284621.11 "Digital, Addressable Fire-Alarm System" for smoke detectors to initiate emergency recall operation, for heat detectors to disconnect power from elevator, and for connection to elevator controllers.

#### 1.3 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include capacities, sizes, performances, operations, safety features, finishes, and similar information.
  - 2. Include Product Data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.
  - 2. Include large-scale layout of car-control station and standby power operation control panel.
  - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch-square Samples of sheet materials; and 4-inch lengths of running trim members.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway and pit layout and dimensions, as indicated on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.
- C. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include emergency, operation, and maintenance manuals.
  - 1. Submit manufacturer's or Installer's standard operation and maintenance manual, according to ASME A17.1/CSA B44 including diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner with terms, conditions, and obligations as set forth in, and in same form as, a "Draft of

Elevator Maintenance Agreement" at end of this Section, starting on date initial maintenance service is concluded.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

#### 1.9 COORDINATION

- A. Coordinate installation of inserts, sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, inserts, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Coordinate locations and dimensions of work specified in other Sections that relates to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways and pits.

#### 1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
  - 2. Warranty Period: One year from date of Final Acceptance.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Basis-of-Design Product:** Subject to compliance with requirements, provide product of **Thyssenkrupp Endura HMRL 3500**



1. Kone
2. Otis Elevator Company

B. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, are manufactured by single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with requirements for accessible elevators in the United States Access Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator seismic requirements in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
2. Project Seismic Design Category: B.
3. Elevator Component Importance Factor: 1.0.
4. Design Site Class C.
5. Provide earthquake equipment required by ASME A17.1/CSA B44.
6. Provide seismic switch required by ASCE/SEI 7.

D. Provide cab enclosure to meet code required stretcher size.

## 2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Descriptions:

1. Elevator Number: 1,
2. Emergency Fire Service Elevator Number(s): 1
3. Rated Load:
  - a. Elevator 1 – 3,500 lb.
4. Rated Speed:

– 150 fpm.

5. Operation System: Elevator 1, - selective-collective automatic operation
6. Auxiliary Operations:
  - a. Standby power operation at Elevator 1.
  - b. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
  - c. Automatic dispatching of loaded car.
  - d. Nuisance-call cancel.
  - e. Loaded-car bypass.
  - f. Distributed parking.
  - g. Off-peak operation.
  - h. Automatic operation of lights and ventilation fans.
  - i. Priority service at all floors.
7. Security Features: Key-switch operation and Car-to-lobby feature.
8. Elevator 1 –Cab:
  - a. Car Enclosure:
    - 1) Inside Width: 80 inches / 6'-8" inches from side wall to side wall.
    - 2) Inside Depth: 65 inches / 5'-5" inches from back wall to front wall (return panels).
    - 3) Inside Height: Not less than 88 inches cab canopy / 7'-4" +/- inches to underside of ceiling.
    - 4) Front Walls (Return Panels): Raised Laminate Wall Panels.
    - 5) Car Fixtures: Brushed stainless steel, No. 4 finish.
    - 6) Side and Rear Wall Panels: Raised Laminate Wall Panels
    - 7) Car Fixtures: Brushed stainless steel, No. 4 finish.
    - 8) Reveals: Satin stainless steel, No. 4 finish.
    - 9) Door Faces (Interior): Brushed stainless steel, No. 4 finish.
    - 10) Door Sills: Aluminum.
    - 11) Ceiling: Brushed stainless steel, No. 4 finish.
    - 12) Handrails: 1-1/2 inches round No. 4 finish, at sides and rear of car.
    - 13) Floor recessed and prepared to receive CT1- (specified in Section 093013 – "Ceramic Tiling" and indicated in Finish Legend).
    - 14) Floor Thickness, Including Setting Materials: 1 inch above plywood subfloor.
  - b. Hoistway Entrance:
    - 1) Width: 42 inches.
    - 2) Height: 84 inches.
    - 3) Type: **Single-speed side opening**. – to allow for a guernsey/stretchers
    - 4) Frames at First, Second Floor: Brushed stainless steel, No. 4 finish.
    - 5) Doors at First, Second Floor: Brushed stainless steel, No. 4 finish.
    - 6) Sills: Aluminum.
    - 7) Hall Fixtures at First, Second Floor: Brushed stainless steel, No. 4 finish.

8) Additional Requirements:

- a) Provide inspection certificate in each car, mounted under acrylic cover with frame made from polished stainless steel, No. 8 finish.
- b) Provide hooks for protective pads in two complete set(s) of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

- A. Elevator Machines: Permanent magnet, variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.
  - 1. Provide regenerative system.
  - 2. Provide regenerative system that complies with the IgCC.
  - 3. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
  - 4. Provide means for absorbing regenerated power when elevator system is operating on standby power.
  - 5. Provide line filters or chokes to prevent electrical peaks or spikes from feeding back into building power system.
- B. Fluid for Hydraulic Buffers: Fire-resistant fluid.
- C. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- D. Machine Beams: Provide steel framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- E. Car Frame and Platform: Bolted- or welded-steel units.
- F. Guides: Roller guides. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Security features shall not affect emergency firefighters' service.
  - 1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car-control stations. Key is removable only in deactivated position.
  - 2. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes all cars in a group to return immediately to lobby and open doors for inspection. On deactivation

by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

## 2.6 DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

## 2.7 CAR ENCLOSURES

- A. General: Provide enameled or powder-coated steel car enclosures to receive removable wall panels, with car roof, access doors, power door operators, and ventilation.
  - 1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.
- B. Materials and Finishes: Manufacturer's standards, but not less than the following:
  - 1. Subfloor: Exterior, B-C Plugged grade plywood, not less than 7/8-inch nominal thickness.
  - 2. Floor Finish: As specified.
  - 3. Stainless-Steel Wall Panels: Flush, formed-metal construction; fabricated from stainless-steel sheet.
  - 4. Fabricate car with recesses and cutouts for signal equipment.
  - 5. Fabricate car door frame integrally with front wall of car.
  - 6. Powder-Coated Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied powder-coat finish; color by Architect control sample.
  - 7. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
  - 8. Sight Guards: Provide sight guards on car doors.
  - 9. Sills: Extruded or machined metal, with grooved surface.
  - 10. Metal Ceiling: Flush panels, with LED downlights in each panel. Align ceiling panel joints.
  - 11. Light Fixture Efficiency: Not less than 35 lumens/W.
  - 12. Ventilation Fan Efficiency: Not less than 3.0 cfm/W.

## 2.8 HOISTWAY ENTRANCES

- A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.
  - 1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.
- B. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252 or UL 10B.
  - 1. Fire-Protection Rating: 1 hour for low rise.
- C. Materials and Fabrication: Manufacturer's standards, but not less than the following:
  - 1. Powder-Coated Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied powder-coat finish; to match Architect selection.
  - 2. Stainless-Steel Frames: Formed from stainless-steel sheet.
  - 3. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches high, on both jambs of hoistway door frames.
  - 4. Powder-Coated Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied powder-coat finish; colors to match Architect selection.
  - 5. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
  - 6. Sight Guards: Provide sight guards on doors matching door edges.
  - 7. Sills: Extruded or machined metal.
  - 8. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

## 2.9 SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
  - 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
  - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

- C. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
  - 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
  - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- E. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Section 283111 "Digital, Addressable Fire-Alarm System."
- F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- G. Hall Push-Button Stations: Provide three hall push-button stations at each landing two buttons for passenger elevators and one button for service elevator.
  - 1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
  - 2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
    - a. Provide for connecting units to building security access system so a card reader can be used to register calls.
  - 3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Section 283111 "Digital, Addressable Fire-Alarm System."
- H. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
  - 1. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
  - 2. Units mounted in both jambs of entrance frame for each elevator.
- I. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
  - 1. At manufacturer's option, audible signals may be placed on cars.

- J. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above each hoistway entrance at ground floor. Provide units with flat faceplate and with body of unit recessed in wall.
  - 1. Integrate ground-floor hall lanterns with hall position indicators.
- K. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.
- L. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switches, as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
- M. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

## 2.10 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.
- C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.
- D. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.
  - 1. Metal surface is satin polished satin relieved after texturing.
- E. Stainless-Steel Bars: ASTM A 276, Type 304.
- F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.
- G. Aluminum Extrusions: ASTM B 221, Alloy 6063.
- H. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500 or UNS No. C77600.
- I. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGL for flat applications and Type BKV for panel backing.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoistways, hoistway openings, and pits as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.
- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
- E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- F. Leveling Tolerance: 1/8 inch, up or down, regardless of load and travel direction.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
  - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
  - 2. Place hall lanterns either above or beside each hoistway entrance.
  - 3. Mount hall lanterns at a minimum of 72 inches above finished floor.



### 3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Operating Test: Load each elevator to rated capacity and operate continuously for 30 minutes over full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of elevator machine during 30-minute test period. Record failure to perform as required.
- C. Standby Power Operating Test: Using standby power source, provide testing to demonstrate elevators meet requirement of Section 2.5.B.1 of this specification.
- D. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

### 3.4 PROTECTION

- A. Temporary Use: Limit temporary use for construction purposes to two elevators. Comply with the following requirements for each elevator used for construction purposes:
  - 1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
  - 2. Provide strippable protective film on entrance and car doors and frames.
  - 3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
  - 4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
  - 5. Do not load elevators beyond their rated weight capacity.
  - 6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).
- B. Check operation of each elevator with Owner's personnel present before date of Final Acceptance and again not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Final Acceptance, maintenance service shall include 12 months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Perform maintenance during normal working hours.
  2. Perform emergency callback service during normal working hours with response time of four hours or less.
  3. Include 24-hour-per-day, 7-day-per-week emergency callback service with response time of four hours or less.

END OF SECTION 142123



## SECTION 210523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Iron butterfly valves with indicators.
3. Check valves.
4. Trim and drain valves.

#### 1.2 DEFINITIONS

- A. NRS: Nonrising stem.
- B. OS&Y: Outside screw and yoke.
- C. SBR: Styrene-butadiene rubber.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, and weld ends.
  3. Set valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher-than-ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.
- D. Protect flanges and specialties from moisture and dirt.

## PART 2 - PRODUCTS

### 2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single manufacturer.

### 2.2 PERFORMANCE REQUIREMENTS

- A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
  - 1. Fire Main Equipment: HAMV - Main Level.
    - a. Ball Valves, System Control: HLUG - Level 3.
    - b. Butterfly Valves: HLXS - Level 3.
    - c. Check Valves: HMER - Level 3.
  - 2. Sprinkler System and Water Spray System Devices: VDGT - Main Level.
    - a. Valves, Trim and Drain: VQGU - Level 1.
- B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
  - 1. Automated Sprinkler Systems:
    - a. Valves.
      - 1) Check valves.
      - 2) Miscellaneous valves.
- C. ASME Compliance:
  - 1. ASME B1.20.1 for threads for threaded-end valves.
  - 2. ASME B16.1 for flanges on iron valves.
  - 3. ASME B31.9 for building services piping valves.
- D. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- E. NFPA Compliance for Valves:
  - 1. Comply with NFPA 13, NFPA 14, NFPA 20, and NFPA 24.
- F. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher, as required by system pressures.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.3 TWO-PIECE BALL VALVES WITH INDICATORS

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. Ames Fire & Waterworks; A Watts Water Technologies Company.
2. NIBCO INC.
3. Victaulic Company.

B. Description:

1. UL 1091, except with ball instead of disc and FM Global approved for indicating valves (butterfly or ball type), Class Number 1112.
2. Minimum Pressure Rating: 175 psig.
3. Body Design: Two piece.
4. Body Material: Forged brass or bronze.
5. Port Size: Full or standard.
6. Seats: PTFE.
7. Stem: Bronze or stainless steel.
8. Ball: Chrome-plated brass.
9. Actuator: Worm gear
10. Supervisory Switch: Internal or external.
11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

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. ALEUM USA.
2. Anvil; an ASC Engineered Solution.
3. Kennedy Valve Company; a division of McWane, Inc.
4. NIBCO INC.
5. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
6. Victaulic Company.
7. Zurn Industries, LLC.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, and EPDM or SBR coated.
7. Actuator: Worm gear.
8. Supervisory Switch: Internal or external.
9. Body Design: Grooved-end connections.

## 2.5 CHECK VALVES

- 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. ALEUM USA.
2. Ames Fire & Waterworks; A Watts Water Technologies Company.
3. Anvil; an ASC Engineered Solution.
4. FEBCO; A WATTS Brand.
5. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
6. Kennedy Valve Company; a division of McWane, Inc.
7. Mueller Co. LLC; Mueller Water Products, Inc.
8. NIBCO INC.
9. Reliable Automatic Sprinkler Co., Inc. (The).
10. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
11. United Brass Works, Inc.
12. Victaulic Company.
13. Viking Group Inc.
14. WATTS; A Watts Water Technologies Company.
15. Zurn Industries, LLC.

- B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded

## 2.6 TRIM AND DRAIN VALVES

### A. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Croker; a Division of Morris Group International.
  - c. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Potter Roemer LLC; a Division of Morris Group International.
  - g. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - h. Victaulic Company.
  - i. WATTS; A Watts Water Technologies Company.
  - j. Zurn Industries, LLC.
2. Description:
  - a. Pressure Rating: 175 psig.
  - b. Body Design: Two piece.
  - c. Body Material: Forged brass or bronze.
  - d. Port size: Full or standard.
  - e. Seats: PTFE.
  - f. Stem: Bronze or stainless steel.
  - g. Ball: Chrome-plated brass.
  - h. Actuator: Handlever.
  - i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
  - j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

### B. Angle Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Fire Protection Products Inc (FPPI); a brand of Anvil International and Smith-Cooper International.
  - b. NIBCO INC.
  - c. United Brass Works, Inc.
2. Description:
  - a. Pressure Rating: 175 psig.
  - b. Body Material: Brass or bronze.



- c. Ends: Threaded.
- d. Stem: Bronze.
- e. Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. NIBCO INC.
  - b. United Brass Works, Inc.
2. Description:
  - a. Pressure Rating: 175 psig.
  - b. Body Material: Bronze with integral seat and screw-in bonnet.
  - c. Ends: Threaded.
  - d. Stem: Bronze.
  - e. Disc Holder and Nut: Bronze.
  - f. Disc Seat: Nitrile.
  - g. Packing: Asbestos free.
  - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 INSTALLATION, GENERAL

- A. Comply with requirements in the following Sections for specific valve-installation requirements and applications:
  - 1. Section 211000 "Water-Based Fire-Suppression Systems" for application of valves in fire-suppression standpipes; wet-pipe, fire-suppression sprinkler systems; and dry-pipe, fire-suppression sprinkler systems.
- 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 valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above the pipe center.
- E. Install valves in position to allow full stem movement.
- F. Install valve tags and signs. Comply with requirements in the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

END OF SECTION 210523



## SECTION 210529 - HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Pipe hangers and supports for fire-suppression piping - metal.
2. Pipe hangers for fire-suppression piping - metal, trapeze type.
3. Fastener systems.
4. Equipment supports.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. For each type of product.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Comply with NFPA 13.
- B. UL Compliance: Comply with UL 203.

#### 2.2 PIPE HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING - METAL

##### A. Pipe Hangers and Supports for Fire-Suppression Piping - Carbon Steel:

1. 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. Anvil; an ASC Engineered Solution.
  - b. B-Line; a division of Eaton, Electrical Sector.
  - c. FNW; Ferguson Enterprises, Inc.
2. Description: Factory-fabricated components, NFPA approved, UL listed, or FM Global approved for fire-suppression piping support.
3. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.

4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

## 2.3 FASTENER SYSTEMS

- A. Fastener System - NFPA/UL/FM Powder-Actuated Fasteners: NFPA-approved, UL-listed, or FM Global-approved threaded-steel stud, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - c. MKT Fastening, LLC.
- B. Fastener System - NFPA/UL/FM Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM Global-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  1. 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. B-Line; a division of Eaton, Electrical Sector.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - e. MKT Fastening, LLC.
  2. Indoor Applications: Zinc coated.
  3. Outdoor Applications: Stainless steel.

## 2.4 EQUIPMENT SUPPORTS

- A. Description: NFPA-approved, UL-listed, or FM Global-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

## 2.5 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.

- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000 psi, 28-day compressive strength.

### PART 3 - EXECUTION

#### 3.1 APPLICATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry static loads within specified loading limits. Minimum static design load used for strength determination is to comply with NFPA 13 requirements .

#### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- B. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2** and larger.
- C. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- D. Pipe Slopes: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- E. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- F. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners in accordance with powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.

2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners in accordance with manufacturer's written instructions. Install in accordance with approvals and listings.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Insulated Piping:
  1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. MSS SP-58, Type 39 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields are to span an arc of 180 degrees.
    - a. MSS SP-58, Type 40 Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
    - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
  5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### 3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to no more than 1-1/2 inches.

### 3.4 PAINTING

#### A. Touchup:

1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - a. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

#### B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- E. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.
- F. Use thermal hanger-shield inserts for insulated piping and tubing.
- G. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
  3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 8.
  4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated or insulated, stationary pipes NPS 3/8 to NPS 8.



5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Comply with NFPA requirements.
- J. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. C-Clamps (MSS Type 23): For structural shapes.
  3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- K. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- L. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 210529

## SECTION 210533 - HEAT TRACING FOR FIRE-SUPPRESSION PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes heat tracing for freeze prevention of fire-suppression piping with self-regulating, parallel-resistance electric heating cables.
- B. Related Requirements:
  - 1. Section 220719 " Plumbing Piping Insulation."

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
  - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- B. Shop Drawings: For electric heating cable.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include diagrams for power, signal, and control wiring.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric heating cables and controls to include in operation and maintenance manuals.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES

- A. Manufacturers: Subject to compliance with requirements, including listing by a NRTL for use on fire protection systems (including branch lines), available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  1. Chromalox, Inc.
  2. RAYCHEM; brand of nVent Electrical plc.
  3. Thermon, Inc.
- B. Source Limitations: Obtain all heat tracing from one manufacturer.
- C. Standard: IEEE 515.1.
- D. Heating Element: Pair of parallel No. 18 minimum AWG, tinned or nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length.
- E. Electrical Insulating Jacket: Flame-retardant polyolefin.
- F. Grounding Cover: Copper or tinned-copper braid.
- G. Cable Cover: Polyolefin outer jacket with ultraviolet inhibitor.
- H. Terminate cable with waterproof, factory-assembled, nonheating leads with connectors at one end, and seal the opposite end watertight. Cable is to be capable of crossing over itself once without overheating.
- I. Maximum Operating Temperature (Power On): 150 deg F.
- J. Maximum Exposure Temperature (Power Off): 185 deg F.
- K. Electrical Components, Devices, and Accessories: Listed and labeled for fire protection use as defined in NFPA 70 and NFPA 13 by a qualified testing agency, and marked for intended location and application. All heating cable used on branch sprinkler piping is to be listed and labeled by a qualified testing agency specifically for this use.
- L. Capacities and Characteristics:
  1. Maximum Heat Output: 8 W/ft..
  2. Piping Diameter: As indicated on sprinkler contractor's "working plans."
  3. Electrical Characteristics for Single-Circuit Connection:
    - a. Volts: 208V.

- b. Phase: One.
- c. Hertz: 60 Hz.
- d. Full-Load Amperes: 12 A maximum.
- e. Maximum Overcurrent Protection: 15 A.

## 2.2 CONTROLS

### A. Control Panel:

- 1. Automatic control with manual on, automatic, and standby/reset switch.
- 2. Remote temperature sensor senses outside air temperature; programmable to energize the cable when temperature falls below 34 to 44 deg F.
- 3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and temperature sensors.
- 4. Minimum 30 A contactor to energize cable or close other contactors.
- 5. Ground-fault protection.
- 6. Single-point control of heat tracing for freeze protection.

## 2.3 ACCESSORIES

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer or as recommended in writing by manufacturer.
- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
  - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
  - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install electric heating cable at locations indicated and install in accordance with NFPA 70 and NFPA 13.
- B. Install electric heating cable across expansion, construction, and control joints in accordance with manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- C. Install electric heating cables after piping has been tested and before insulation is installed.
- D. Install electric heating cables in accordance with IEEE 515.1.
- E. Install insulation over piping with electric cables in accordance with Section 220719 "Plumbing Piping Insulation."
- F. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- G. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Install temperature-control units in an accessible location and according to manufacturer's written instructions. Locate sensing bulbs to sense outside air temperature in a location where it will not be affected by direct sunlight or other heat sources.
- I. Install control panels and distribution panels in accordance with manufacturer's written instructions. Coordinate with Architect to gain approval for location(s) prior to installation.
- J. Install and connect outside air and pipe temperature sensors.

### 3.3 ELECTRICAL CONNECTIONS

- A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Connect heat-tracing controls to fire-alarm system in accordance with NFPA 13. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm Systems."
- D. Connect temperature-control unit to interrupt power supply to electric heating cable when outside air is above set point.
- E. Connect remote electronic temperature sensors.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Perform tests after cable installation but before application of coverings, such as insulation, wall or ceiling construction, or concrete.
  - 2. Test cables for electrical continuity and insulation integrity before energizing.
  - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 PROTECTION

- A. Protect installed heating cables, including nonheating leads, from damage.
- B. Remove and replace damaged heat-tracing cables.

END OF SECTION 210533



## SECTION 211000 - WATER-BASED FIRE-SUPPRESSION SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Fire-suppression piping, fittings, and appurtenances.
2. System control valves.
3. Fire-suppression piping specialties.
4. Sprinklers.
5. Alarm devices.
6. Pressure gauges.

##### B. Related Requirements:

1. Section 331413 "Public Water Utility Distribution Piping" for site fire-suppression water-services.

#### 1.2 DEFINITIONS

- ##### A. Standard-Pressure Fire-Suppression System Piping: Piping designed to operate at working pressure of 175 psig maximum.

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. For each type of product.
  - a. Include construction details, material descriptions, dimensions of individual components and profiles.
  - b. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

##### B. Shop Drawings:

1. Prepare in accordance with NFPA 13 section "Working Plans."
  - a. Include plans, elevations, and sections of the system piping and details.
  - b. Include detailed riser diagram and schematic diagram showing system supply, supply connection, devices, valves, pipe and fittings, as well as the delineation of the standard-pressure and high-pressure portions of the fire-suppression system.



- c. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  2. Prepare computer-generated hydraulic calculations in accordance with the following:
    - a. Name of hydraulic program used.
    - b. Water supply information, including fire hydrant flow test data report.
  3. Submit documents and calculations prepared by minimum NICET Level III-certified technician, "Water-Based Systems Layout." NICET certified-technician submittals are to include the following information on each drawing title block: technician's name, NICET certification number, and NICET certification specialty area and level.
  4. Include diagrams for power, signal, and control wiring.
- C. Delegated Design Submittals: For fire-suppression systems indicated to comply with performance requirements and design criteria, including analysis data, prepared by minimum NICET Level III-certified technician, "Water-Based Systems Layout." NICET certified-technician submittals are to include the following information on each drawing title block: technician's name, NICET certification number, and NICET certification specialty area and level.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and NICET-certified technician.
- B. Design Data: Approved fire-suppression piping working plans, prepared in accordance with NFPA 13, including documented approval by AHJs, and including hydraulic calculations if applicable.
- C. Welding certificates.
- D. Field Test Reports:
  1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
  2. Fire-hydrant flow test report.
- E. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-suppression systems and specialties to include in emergency, operation, and maintenance manuals.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrenches for all sprinklers.
  - 2. System control valves.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems. Base calculations on results of updated fire-hydrant flow test, with SCO required adjustments (reduction of 10 psi to static and residual pressure and reduction of 10% residual flow).
    - a. Design Responsibility: Preparation of working plans, calculations, and field test reports by minimum NICET Level III-certified technician, "Water-Based Systems Layout."
- B. Welding Qualifications: Qualify procedures and operators in accordance with ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Automatic wet-pipe sprinkler system.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Suppression System Components, Devices, and Accessories: Listed in UL's "Fire Protection Equipment Directory" and FM Approvals' "Approval Guide."
- 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. Fire-suppression system equipment, specialties, accessories, installation, and testing to comply with NFPA 13.
- D. Standard-Pressure Piping System Component: Listed for 175 psig minimum working pressure.

- E. Delegated Design: Engage a minimum NICET Level III-certified technician, “Water-Based Systems Layout” to design fire-suppression systems. The construction documents show a system layout that has been coordinated with the architect. Changes to this layout may be suggested, but approval will require the consent of the architect, who will give strong consideration to the aesthetic impact. The layout on the construction documents includes exposed installation of wet system piping under combustible construction, which will be heat-traced and insulated. The use of flexible dry sprinklers where possible will be favorably considered.
1. Fire-Hydrant Flow Test:
    - a. Available fire-hydrant flow test records are indicated on the construction drawings.
    - b. Per SCO guidelines, the contractor shall perform or obtain an updated fire-hydrant flow test and record the following conditions:
      - 1) Date.
      - 2) Time
      - 3) Who conducted the test (name, company, etc.).
      - 4) Location of Residual Fire Hydrant R.
      - 5) Location of Flow Fire Hydrant F.
      - 6) Static Pressure at Residual Fire Hydrant R.
      - 7) Measured Flow at Flow Fire Hydrant F.
      - 8) Residual Pressure at Residual Fire Hydrant R.
    - c. Fire-hydrant flow test must be performed within previous 12 months prior to completion of sprinkler shop drawings and hydraulic calculations.
  2. Margin of Safety for Available Water Flow and Pressure: No margin of safety is required, but fire-hydrant flow test used for basis of hydraulic calculations must be adjusted per SCO guidelines, which require a 10 psi reduction in static and residual pressures and a 10 percent reduction in residual flow.
  3. Sprinkler Occupancy Hazard Classifications: As indicated on the construction drawings.
  4. Minimum Density for Automatic-Sprinkler Piping Design: As indicated on the construction drawings.
  5. Maximum protection area per sprinkler is per NFPA 13 and in accordance with UL listing.
  6. Total Combined Hose-Stream Demand Requirement: As indicated on the construction drawings.
- F. Obtain documented approval of fire-suppression system design from AHJs.

## 2.3 FIRE-SUPPRESSION PIPING, FITTINGS, AND APPURTENANCES

### A. Steel Pipe, Fittings, and Appurtenances:

1. Schedule 40 Steel Pipe: Black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
  - a. Standards:
    - 1) UL 852.
    - 2) FM 1630.
  - b. Factory-applied exterior coating.
  - c. Factory-applied bacterial-resistant internal coating to reduce microbiologically influenced corrosion.
  - d. Pipe ends may be factory or field formed to match joining method.
2. Schedule 10 Steel Pipe: Black-steel pipe, ASTM A53/A53M, ASTM A135/A135M, or ASTM A795/A795M.
  - a. Standards:
    - 1) UL 852.
    - 2) FM 1630.
  - b. Factory-applied exterior coating.
  - c. Factory-applied bacterial resistant internal coating to reduce microbiologically influenced corrosion.
  - d. Pipe ends may be factory or field formed to match joining method.
3. Steel Pipe Nipples: Black steel, ASTM A733, made of ASTM A53/A53M, standard-weight, seamless steel pipe with threaded ends.
4. Steel Couplings: Uncoated steel, ASTM A865/A865M, threaded.
5. Gray-Iron Threaded Fittings: Uncoated gray-iron threaded fittings, ASME B16.4, Class 125, standard pattern.
6. Malleable- or Ductile-Iron Unions: ASME B16.3.
7. Cast-Iron Flanges: ASME B16.1, Class 125.
8. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
  - a. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
    - 1) Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
    - 2) Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
  - b. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1 carbon steel unless otherwise indicated.

9. Steel Welding Fittings: ASTM A234/A234M and ASME B16.9.
  - a. 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.
10. Grooved-Joint, Steel-Pipe Appurtenances:
  - 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) Gruvlok; an ASC Engineered Solution.
    - 2) SPF/Anvil; an ASC Engineered Solution.
    - 3) Smith-Cooper International.
    - 4) Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
    - 5) Victaulic Company.
  - b. Pressure Rating: 175 psig minimum.
  - c. Grooved-End Fittings for Steel Piping: Painted or uncoated grooved-end fittings, ASTM A47/A47M, malleable-iron casting or ASTM A536, ductile-iron casting, with dimensions matching steel pipe.
  - d. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

## 2.4 SYSTEM CONTROL VALVES

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- B. Pressure Rating:
  1. Standard-Pressure Piping Valves: 175 psig minimum.
- C. Body Material: Cast or ductile iron.
- D. Size: Same as connected piping.
- E. End Connections: Flanged or grooved.
- F. System Control Valve, Riser Check Valve:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Reliable Automatic Sprinkler Co., Inc. (The).

- b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - c. Victaulic Company.
  - d. Viking Group Inc.
- 2. Standard: UL 193.
- 3. Design: For horizontal or vertical installation.
- 4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, and pressure gauges.

## 2.5 FIRE-SUPPRESSION PIPING SPECIALTIES

### A. Branch Outlet Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - b. Victaulic Company.
  - c. AGF Manufacturing, Inc.
- 2. Standard: UL 213.
- 3. Pressure Rating: 175 psig minimum.
- 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
- 5. Type: Mechanical-tee and -cross fittings.
- 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
- 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
- 8. Branch Outlets: Grooved, plain-end pipe, or threaded.

### B. Flow Detection and Test Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. AGF Manufacturing, Inc.
  - b. Reliable Automatic Sprinkler Co., Inc. (The).
  - c. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - d. Victaulic Company.
- 2. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
- 3. Pressure Rating: 175 psig minimum.
- 4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. AGF Manufacturing, Inc.
  - b. Croker; a Division of Morris Group International.
  - c. Potter Roemer LLC; a Division of Morris Group International.
2. Standard: UL 199.
3. Pressure Rating: 175 psig.
4. Body Material: Brass.
5. Size: Same as connected piping.
6. Inlet: Threaded.
7. Drain Outlet: Threaded and capped.
8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Reliable Automatic Sprinkler Co., Inc. (The).
  - b. Viking Group Inc.
  - c. ASC Engineered Solutions
2. Standard: UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

E. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Easyflex, Inc.
  - b. Flexhead; an ASC Engineered Solution.
  - c. Victaulic Company.
2. Standards:

- a. UL 2443.
  - b. FM 1637.
3. Description: UL listed and FM approved Type 304 stainless steel flexible hose with fully braided cover for connection to sprinkler, and with bracket for connection to ceiling grid using tamper proof screws.
  4. Pressure Rating: 175 psig minimum.
  5. Size: Same as connected piping, for sprinkler.
  6. Installation: Must be in strict accordance with manufacturer's guidelines, including number of bends and bend radii.
  7. Length: Maximum 60-inches.
  8. Diameter: 1-inch minimum "true bore" corrugated hose diameter.

F. Automatic Air Vent:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. AGF Manufacturing, Inc.
  - b. CLA-VAL.
  - c. Engineered Corrosion Solutions.
  - d. Metraflex Company (The).
  - e. Reliable Automatic Sprinkler Co., Inc. (The).
2. Description: Automatic air vent that automatically vents trapped air without human intervention. Approved for use in wet-pipe fire-suppression system.
3. Vents oxygen continuously from system.
4. Float valve to prevent water discharge.
5. Minimum Water Working Pressure Rating: 175 psig.

2.6 SPRINKLERS

- 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. Reliable Automatic Sprinkler Co., Inc. (The).
  2. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  3. Victaulic Company.
  4. Viking Group Inc.
- B. Standards:
1. UL 199.
  2. FM 2000.
- C. Listed in UL's "Fire Protection Equipment Directory" or FM Approvals' "Approval Guide."



D. Pressure Rating for Sprinklers:

1. Standard Automatic Sprinklers: 175 psig minimum.

E. Sprinklers, Automatic Wet with Heat-Responsive Element:

1. 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.
2. Standard Spray, Quick Response:
  - a. Upright.
  - b. Pendent.
  - c. Flat, concealed pendent.
  - d. Vertical sidewall.
  - e. Horizontal sidewall.

F. Sprinklers, Automatic Dry with Heat-Responsive Element:

1. Standard Spray, Quick Response:
  - a. Pendent.
  - b. Horizontal sidewall.

G. Sprinkler Finishes: Bronze.

H. Special Coatings: Wax, lead and corrosion-resistant paint.

I. Sprinkler Guards and Water Shields:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Reliable Automatic Sprinkler Co., Inc. (The).
  - b. Tyco Fire Products; brand of Johnson Controls International plc, Building Solutions North America.
  - c. Victaulic Company.
  - d. Viking Group Inc.
2. Standard: UL 199.
3. Description: Wire cage with fastening device for attaching to sprinkler.

2.7 ALARM DEVICES

- A. Match alarm-device material and connection types to piping and equipment materials and connection types.

B. Electrically Operated Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Notifier; Honeywell International, Inc.
  - b. Potter Electric Signal Company, LLC.
2. Electric Bell:
  - a. Standard: UL 464.
  - b. Type: Vibrating, metal alarm bell.
  - c. Size: 6-inch minimum diameter.
  - d. Voltage: 24 V dc, connected to fire alarm control panel.
  - e. Finish: Red-enamel or polyester powder-coat factory finish, suitable for outdoor use with approved and listed weatherproof backbox.

C. Water-Flow Indicators:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Potter Electric Signal Company, LLC.
  - b. System Sensor; Honeywell International, Inc.
  - c. Viking Group Inc.
2. Standard: UL 346.
3. Water-Flow Detector: Electrically supervised.
4. 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 that sends signal if removed.
5. Type: Paddle operated.
6. Pressure Rating: 250 psig.
7. Design Installation: Horizontal or vertical.

D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Kennedy Valve Company; a division of McWane, Inc.
  - b. Potter Electric Signal Company, LLC.
  - c. System Sensor; Honeywell International, Inc.
2. Standard: UL 346.

3. Type: Electrically supervised.
4. Design: Signals that controlled valve is in other than fully open position.
5. Wire Terminal Designations: Indicates normal switch position when switch is properly installed on valve and valve is fully open.
6. 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.
7. OS&Y Valve Supervisory Switches:
  - a. One or two single-pole, double-throw switches.
  - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
  - c. Visual Switch Indication: Indicates device is properly installed and OS&Y valve is fully open.
  - d. Mounting Hardware: Mounting bracket to grip valve yoke and prevent movement of switch assembly on OS&Y valve.
  - e. Trip Rod Length: Adjustable
8. Butterfly Valve Supervisory Switches:
  - a. Two single-pole, double-throw switches.
  - b. NEMA Rating: NEMA 4 and NEMA 6P enclosures suitable for mounting in any position indoors or outdoors.
  - c. Mounting Hardware: Removable nipple.
  - d. Trip Rod Length: Adjustable
9. Ball Valve Supervisory Switches:
  - a. One single-pole, double-throw switch.
  - b. NEMA Rating: NEMA 4 enclosure suitable for mounting in any position indoors or outdoors.
  - c. Mounting Hardware: Suitable for mounting directly to pipe, ball valves, or backflow preventers sized from up to NPS 2.

## 2.8 PRESSURE GAUGES

- 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. AGF Manufacturing, Inc.
  2. Ametek U.S. Gauge.
  3. Ashcroft Inc.
  4. Brecco Corporation.
  5. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

- D. Pressure Gauge Range: 0 to 250 psig minimum.
- E. Water System Piping Gauge: Include "WATER" or "AIR/WATER" label on dial face.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Perform fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article.
  - 1. Flow test is to be performed to meet the criteria established by NFPA 13.
  - 2. Flow test is to be conducted in accordance with NFPA 291.
  - 3. Test is to be performed during a period of ordinary demand for the water system.
    - a. To obtain satisfactory test results of expected flow or rated capacities, sufficient discharge should be achieved to cause drop of at least 10 percent.
  - 4. Pitot readings are to be taken at the 2-1/2-inch orifice connection.
  - 5. The pitot reading is to range from 10 to 35 psig.
  - 6. Open additional hydrant outlets as needed to control pitot readings.
  - 7. The pitot pressure and corresponding residual pressure readings are to be taken consecutively as pressure fluctuates between a high number and low number.
- B. Flow Test Data Written Report:
  - 1. Flow data report is to be written in accordance with NFPA 291.
  - 2. Flow data report is to include a copy of all flow data recorded during the test, including a site plan showing the tested fire hydrants with respect to the fire water service to the building. Site plan is to indicate which hydrant was flowed and which hydrant was used for pressure reading. Provide date of test, name of testing agency, and name of individual performing test.
- C. Water Supply Curve: Provide water supply curve based on the lowest supply for a given set of test data. For a given residual pressure reading, the supply is to be graphed utilizing the corresponding pitot pressure/flow reading and static pressure reading.
- D. Documentation is to include calibration certifications for gauges used in the flow tests. The certifications are to be from within the previous six (6) months from a reputable agency recognized for certifying pressure gauges.
- E. Report flow test results promptly and in writing. A copy of the flow test data report is to be submitted with the hydraulic calculations.

### 3.2 INSTALLATION OF FIRE-SUPPRESSION WATER-SERVICE PIPING

- A. Comply with requirements for fire-suppression water-service piping in Section 331413 "Public Water Utility Distribution Piping."

### 3.3 INSTALLATION OF FIRE-SUPPRESSION PIPING

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
  - 1. Deviations from approved working plans for piping require written approval from AHJs. File written approval with Architect before deviating from approved working plans.
  - 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of fire-suppression piping.
- C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install inspector's test connections in sprinkler system piping, complete with shutoff valve, and sized and located at the sprinkler riser.
- G. Install fire-suppression system piping with drains for complete system drainage. Extend drain piping to exterior of building where possible.
- H. Install alarm devices in piping systems.
- I. Install hangers and supports for fire-suppression piping in accordance with NFPA standards. Comply with requirements for hanger materials in NFPA standards.
- J. Install pressure gauges on riser. Include pressure gauges with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they are not subject to freezing.
- K. Fill wet-type fire-suppression system piping with water.
- L. Install electric heating cables and pipe insulation on fire-suppression piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 220719 "Plumbing Piping Insulation."

- M. Install sleeves for piping penetrations of walls, ceilings, and floors.
- N. Install sleeve seals for piping penetrations of concrete walls and slabs.
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.4 INSTALLATION OF PIPING JOINTS

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints in accordance with AWS D10.12M/D10.12, using qualified processes and welding operators in accordance with "Quality Assurance" Article.
  - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe joints.
- J. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe in accordance with AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings in accordance with AWWA C606 for steel-pipe grooved joints.

- K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.5 INSTALLATION OF VALVES AND SPECIALTIES

- A. Install listed fire-suppression system control valves, trim and drain valves, specialty valves and trim, controls, and specialties in accordance with manufacturer's installation instructions, NFPA standards, and AHJ.
- B. Install listed fire-suppression system shutoff valves in supervised open position, 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. System Control Valves:
  - 1. Install riser check valves.
- D. Air Vent:
  - 1. Provide at least one air vent at high point in each wet-pipe fire-suppression system. Connect vent into top of fire-suppression piping.
  - 2. Provide dielectric union for dissimilar metals, ball valve, and strainer upstream of automatic air vent.
  - 3. Pipe from outlet of air vent to drain.

### 3.6 INSTALLATION OF SPRINKLERS

- A. Install sprinklers in suspended ceilings symmetrically in center of acoustical ceiling panels within tolerance of **1/2 inch**. Coordinate entire pattern of sprinkler locations with approved reflected ceiling plan.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Sprinklers suspended ceilings (acoustical tile and gypsum board) are to be Installed sprinklers into flexible, sprinkler hose fittings, and hose installed into bracket on ceiling.

### 3.7 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping in accordance with requirements of NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Perform the following tests and inspections:
  - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect fire-suppression systems in accordance with NFPA standards.
  - 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.
  - 7. Verify that sprinklers original factory finish has not been contaminated with dirt, debris, or paint. Sprinklers containing other-than-original factory finish are to be considered defective and replaced with new products. Repair and/or cleaning is not acceptable.
- C. Fire-suppression piping system will be considered defective if it does not pass tests and inspections.
- D. Fire-suppression piping system components considered defective during testing will be replaced with new components. Repair of defective components is not acceptable.
- E. Prepare test and inspection reports.

### 3.9 CLEANING

- A. Clean dirt and debris from fire-suppression system piping, system control valves, sprinklers, and associated components.
- B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

### 3.10 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain the system, including but not limited to valves and heat-tracing.

### 3.11 PIPING SCHEDULE

- A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- B. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 (DN 50) and Smaller, to Be One of the Following:



1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  2. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints
- C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 and larger (DN 65 and larger), to Be One of the Following, except that all exterior piping shall be Schedule 40:
1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
  2. Schedule 40, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
  3. Schedule 10, steel pipe with roll-grooved ends; painted or uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

### 3.12 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright or sidewall sprinklers.
  2. Rooms with Suspended Ceilings: Flat concealed sprinklers.
  3. Wall Mounting: Horizontal sidewall sprinklers.
  4. Spaces Subject to Freezing: Upright, pendent, Dry pendent, Dry sidewall and sidewall sprinklers as indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Upright, Pendent, and Sidewall Sprinklers: Rough bronze and wax coated where exposed to acids, chemicals, or other corrosive fumes.
  2. Flat Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

END OF SECTION 211000

## SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

#### 2.2 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
  2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- C. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
1. Interior Partitions:
    - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves

END OF SECTION 220517

## SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Escutcheons.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  1. Escutcheons for New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
- h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
- j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
- k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons using new materials.

END OF SECTION 220518

## SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Bimetallic-actuated thermometers.
  - 2. Thermowells.
  - 3. Dial-type pressure gages.
  - 4. Gage attachments.
  - 5. Test plugs.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 BIMETALLIC-ACTUATED THERMOMETERS

- 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. Ashcroft Inc.
  - 2. Ernst Flow Industries.
  - 3. Marsh Bellofram.
  - 4. Miljoco Corporation.
  - 5. Moeller Instrument Company, Inc.
  - 6. Nanmac Corporation.
  - 7. Noshok.
  - 8. Palmer Wahl Instrumentation Group.
  - 9. REOTEMP Instrument Corporation.
  - 10. Tel-Tru Manufacturing Company.

11. Terrice, H. O. Co.
12. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
13. Weiss Instruments, Inc.
14. WIKA Instrument Corporation - USA.
15. Winters Instruments - U.S.

- B. Standard: ASME B40.200.
- C. Case: Liquid-filled type(s); stainless steel with 3-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, rigid, back and rigid, bottom, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

## 2.2 THERMOWELLS

- A. Thermowells:
1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
  3. Material for Use with Copper Tubing: CNR or CUNI.
  4. Material for Use with Steel Piping: CRES or CSA.
  5. Type: Stepped shank unless straight or tapered shank is indicated.
  6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
  7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
  8. Bore: Diameter required to match thermometer bulb or stem.
  9. Insertion Length: Length required to match thermometer bulb or stem.
  10. Lagging Extension: Include on thermowells for insulated piping and tubing.
  11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.
- B. Heat-Transfer Medium: Mixture of graphite and glycerin.

## 2.3 PRESSURE GAGES

### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. AMETEK, Inc.; U.S. Gauge.
  - b. Ashcroft Inc.
  - c. Ernst Flow Industries.
  - d. Flo Fab Inc.
  - e. Marsh Bellofram.
  - f. Miljoco Corporation.
  - g. Noshok.
  - h. Palmer Wahl Instrumentation Group.
  - i. REOTEMP Instrument Corporation.
  - j. Tel-Tru Manufacturing Company.
  - k. Trerice, H. O. Co.
  - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  - m. Weiss Instruments, Inc.
  - n. WIKA Instrument Corporation - USA.
  - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

## 2.5 TEST PLUGS

- 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. Flow Design, Inc.
  2. Miljoco Corporation.
  3. National Meter, Inc.
  4. Peterson Equipment Co., Inc.
  5. Sisco Manufacturing Company, Inc.
  6. Trerice, H. O. Co.
  7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: EPDM self-sealing rubber.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
  1. Inlet and outlet of each water heater.
  2. Discharge of each domestic water pump.

J. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Outlet of each water heater.
3. Inlet and outlet of each domestic water booster pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be the following:

1. Bimetallic-actuated thermometers.
2. Test plug with EPDM self-sealing rubber inserts.

- B. Thermometers at outlet of each thermostatic mixing valve shall be the following:

1. Bimetallic-actuated thermometers.
2. Test plug with EPDM self-sealing rubber inserts.

- C. Thermometers at discharge of each domestic water pump shall be the following:

1. Bimetallic-actuated thermometers.
2. Test plug with EPDM self-sealing rubber inserts.

- D. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

- B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each water service into building shall be the following:

1. Liquid-filled, direct-mounted, metal case.

2. Test plug with EPDM self-sealing rubber inserts.

B. Pressure gages at outlet of each domestic water heater shall be the following:

1. Liquid-filled, direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

C. Pressure gages at inlet and outlet of each domestic water booster pump shall be the following:

1. Liquid-filled, direct-mounted, metal case.
2. Test plug with EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Water Piping: 0 to 200 psi.

END OF SECTION 220519

## SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder-joint connections.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Types:

1. Handlever: For quarter-turn valves smaller than NPS 4.

G. Valves in Insulated Piping:

1. Include 2-inch stem extensions.

2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

## 2.2 BRASS BALL VALVES

### A. Brass Ball Valves, Two-Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. American Valve, Inc.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. DynaQuip Controls.
  - d. FNW; Ferguson Enterprises, Inc.
  - e. Hammond Valve.
  - f. Jomar Valve.
  - g. KITZ Corporation.
  - h. Legend Valve & Fitting, Inc.
  - i. Marwin Valve; Richards Industries.
  - j. Milwaukee Valve Company.
  - k. Red-White Valve Corp.
  - l. Stockham; a Crane Co. brand.
  - m. WATTS.
2. Description:
  - a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Brass.
  - h. Ball: Chrome-plated brass.
  - i. Port: Full.

### B. Brass Ball Valves, Two-Piece with Regular Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. FNW; Ferguson Enterprises, Inc.
  - c. Hammond Valve.
  - d. Legend Valve & Fitting, Inc.

- e. Milwaukee Valve Company.
  - f. WATTS.
2. Description:
- a. Standard: MSS SP-110.
  - b. CWP Rating: 600 psig.
  - c. Body Design: Two piece.
  - d. Body Material: Forged brass.
  - e. Ends: Threaded and soldered.
  - f. Seats: PTFE.
  - g. Stem: Brass.
  - h. Ball: Chrome-plated brass.
  - i. Port: Regular.

### PART 3 - EXECUTION

#### 3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

#### 3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- B. Select valves with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

#### 3.3 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 3 and Smaller:
  - 1. Brass Valves: May be provided with solder-joint ends instead of threaded ends.
  - 2. Brass ball valve, one piece.
  - 3. Brass ball valves, two-piece with full port and brass trim.

END OF SECTION 220523.12



## SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Bronze swing check valves.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G and NSF 372.

### PART 2 - PRODUCTS

#### 2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
3. ASME B16.18 for solder joint.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Bypass and Drain Connections: MSS SP-45.



## 2.2 BRONZE SWING CHECK VALVES

### A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Jenkins Valves; a Crane Co. brand.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
  - e. Red-White Valve Corp.
  - f. Stockham; a Crane Co. brand.
2. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded or soldered. See valve schedule articles.
  - f. Disc: Bronze.

## PART 3 - EXECUTION

### 3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow in horizontal position with hinge pin level.

### 3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered.

### 3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller: Bronze swing check valves bronze disc, Class 125, with threaded end connections.

END OF SECTION 220523.14

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## SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing 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 multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
  2. Design seismic-restraint hangers and supports for piping and equipment

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
1. Trapeze pipe hangers.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## 1.5 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel
- B. Copper Pipe Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel

### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.4 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.6 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi28-day compressive strength.

# PART 3 - EXECUTION

## 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

D. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.
  - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
  - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
  - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
- 4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
- 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

### 3.3 PAINTING

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

### 3.4 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- F. Use thermal-hanger shield inserts for insulated piping and tubing.
- G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:



1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
- H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  8. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

- M. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529



## SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pipe labels.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

### PART 2 - PRODUCTS

#### 2.1 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: Size letters according to ASME A13.1 for piping

### PART 3 - EXECUTION

#### 3.1 PIPE LABEL INSTALLATION

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Revise "Pipe Label Locations" Paragraph below to suit Project.

- C. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
1. Low-Pressure Compressed Air Piping:
    - a. Background: Safety blue.
    - b. Letter Colors: White.
  2. Domestic Water Piping
    - a. Background: Safety green.
    - b. Letter Colors: White
  3. Sanitary Waste and vent Piping:
    - a. Background Color: Safety gray
    - b. Letter Color: White

END OF SECTION 220553

## SECTION 220719 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold and hot-water piping.
  - 2. Domestic recirculating hot-water piping.
  - 3. Supplies and drains for handicap-accessible lavatories and sinks.
  - 4. Exposed fire protection piping below exterior overhangs and roofs.
- B. Related Sections:
  - 1. Section 220716 "Plumbing Equipment Insulation."

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

### PART 2 - PRODUCTS

#### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- D. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  - 4. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: 60 percent by volume and 66 percent by weight.
  - 4. Color: White.

## 2.5 SEALANTS

- A. Joint Sealants for Cellular-Glass Products:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.
2. Color: White
3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
  - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.



## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 6.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.
  - 4. Elongation: 2 percent.
  - 5. Tensile Strength: 40 lbf/inch in width.
  - 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Width: 2 inches.
  - 2. Thickness: 6 mils.
  - 3. Adhesion: 64 ounces force/inch in width.
  - 4. Elongation: 500 percent.
  - 5. Tensile Strength: 18 lbf/inch in width.

## 2.10 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with or
- B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Cleanouts.

### 3.3 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  - 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  - 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.5 INSTALLATION OF CELLULAR-GLASS INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

#### C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  - 1. Install pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  - 4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install mitered sections of pipe insulation.
  - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 3. Install insulation to flanges as specified for flange insulation application.
  - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

### 3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099123 "Interior Painting."
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.10 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  1. Underground piping.
  2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold, Hot and Recirculated Hot Water: Insulation shall be the following:
  - 1. Flexible Elastomeric 1 inch thick.
- B. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: Insulation shall be the following:
  - 1. Flexible Elastomeric: 1/2 inch thick.

3.12 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Fire Protection Piping Where Heat Tracing Is Installed: Insulation shall be the following:
  - 1. Flexible Elastomeric: 1 inches thick.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
  - 1. PVC 20 mils
  - 2. thick.
- D. Piping, Exposed:
  - 1. PVC 20 mils thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material.
- B. Fire Protection Piping, Exposed:
  - 1. **Painted** Aluminum, **Smooth with Z-Shaped Locking Seam**: **0.016** thick. Refer to specification section 099113 for exterior paint requirements.

END OF SECTION 220719



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## SECTION 221116 - DOMESTIC WATER PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.

#### 1.3 SUBMITTALS

- A. Product Data: For the following products:
  - 1. Domestic water pipe and fittings.
  - 2. Dielectric fittings.
- B. Water Samples: Specified in "Cleaning" Article.

#### 1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.

### PART 2 - PRODUCTS

#### 2.1 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
  - 1. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

## 2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

## 2.3 TRANSITION FITTINGS

- A. General Requirements:
  1. Same size as pipes to be joined.
  2. Pressure rating at least equal to pipes to be joined.
  3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

## 2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. Hart Industries International, Inc.
    - d. Jomar International Ltd.
    - e. Matco-Norca, Inc.
    - f. McDonald, A. Y. Mfg. Co.
    - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - h. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Pressure Rating: 150 psig.
- c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Capitol Manufacturing Company.
- b. Central Plastics Company.
- c. Matco-Norca, Inc.
- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- e. Wilkins; a Zurn company.

2. Description:

- a. Standard: ASSE 1079.
- b. Factory-fabricated, bolted, companion-flange assembly.
- c. Pressure Rating: 150 psig.
- d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

### PART 3 - EXECUTION

#### 3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations.
- B. Install shutoff valve, hose-end drain valve, strainer, and pressure gage inside the building at each domestic water service entrance.
- C. Install domestic water piping level without pitch and plumb.
- D. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- G. Install piping adjacent to equipment and specialties to allow service and maintenance.
- H. Install piping to permit valve servicing.
- I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- M. Install sleeves for piping penetrations of walls, ceilings, floors, and exterior walls above grade.
- N. Install sleeve seals for piping penetrations of exterior concrete walls below grade.
- O. Install escutcheons for piping penetrations of walls, ceilings, and floors.

### 3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- D. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.3 VALVE INSTALLATION

- A. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use butterfly valves for piping NPS 2-1/2 and larger.
- B. Install calibrated balancing valves in each hot-water circulation return branch. Set calibrated balancing valves to flows indicated on the Drawings.

### 3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

### 3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.
- C. Dielectric Fittings for NPS 2-1/2 and Larger: Use dielectric flanges.

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support products and installation.
  - 1. Install pipe hangers for horizontal piping.
  - 2. Install pipe support clamps for vertical piping.
  - 3. Vertical Piping: MSS Type 8 or 42, clamps.
  - 4. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
  - 5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 and Larger: 10 feet with 1/2-inch rod.

- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code.
  3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.8 IDENTIFICATION

- A. Identify system components.

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
  - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping with air or water.
2. Test for leaks and defects in new piping. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Close shutoff valves to branch distribution piping serving fixtures and equipment.
5. Cap and subject piping to a pressure of 1-1/2 times the working pressure or 100 psig (whichever is greater). Isolate test source and allow to stand for 15 minutes. Leaks and loss in test pressure constitute defects that must be repaired.
6. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
7. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Adjust calibrated balancing valves to flows indicated.
4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.



5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
6. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Domestic water piping NPS 1/2 and larger shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; wrought-copper solder-joint fittings; and brazed joints.

### 3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  2. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116



## SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
  - 1. Backflow preventers.
  - 2. Balancing valves.
  - 3. Strainers.
  - 4. Hose bibbs.
  - 5. Wall hydrants.
  - 6. Water hammer arresters.
  - 7. Air vents.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NSF Compliance:

1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

## PART 2 - PRODUCTS

### 2.1 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers - Domestic Water Systems:
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. Ames Co.
    - b. Conbraco Industries, Inc.
    - c. FEBCO.
    - d. Watts; a Watts Water Technologies Company.
    - e. Zurn Industries.
  2. Standard: ASSE 1013.

### 2.2 BALANCING VALVES

- A. Copper-Alloy Calibrated Balancing Valves:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong International, Inc.
    - b. Flo Fab Inc.
    - c. ITT Industries; Bell & Gossett Div.
    - d. NIBCO INC.
    - e. Taco, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
  2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
  3. Body: Brass or bronze.
  4. Size: Same as connected piping, but not larger than NPS 2.
  5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

### 2.3 STRAINERS FOR DOMESTIC WATER PIPING

- A. Y-Pattern Strainers:
  1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
  2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
  3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  4. Screen: Stainless steel with round perforations, unless otherwise indicated.
  5. Perforation Size:

- a. Strainers NPS 2 and Smaller: 0.020 inch.
- b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
- 6. Drain: Pipe plug.

B. Icemaker Outlet Boxes:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. Acorn Engineering Company.
  - b. Guy Gray Manufacturing Co., Inc.
  - c. Oatey.
  - d. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Description: Recessed, epoxy-painted-steel box and faceplate with valved fitting with water hammer arrestor.

2.4 HOSE BIBBS

A. Hose Bibbs:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products.
  - f. Woodford Manufacturing Company; a division of WCM Industries, Inc.
  - g. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
- 2. Standard: ASME A112.18.1 for sediment faucets.

2.5 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - a. MIFAB, Inc.
  - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - c. Woodford Manufacturing Company.
  - d. Zurn Plumbing Products Group.
- 2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.

2.6 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. MIFAB, Inc.
  - c. Precision Plumbing Products, Inc.
  - d. Sioux Chief Manufacturing Company, Inc.
  - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## 2.7 AIR VENTS

- A. Welded-Construction Automatic Air Vents:
  1. Body: Stainless steel.
  2. Pressure Rating: 150-psig minimum pressure rating.
  3. Float: Replaceable, corrosion-resistant metal.
  4. Mechanism and Seat: Stainless steel.
  5. Size: NPS 3/8 minimum inlet.
  6. Inlet and Vent Outlet End Connections: Threaded.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install backflow preventers in each water supply that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install Y-pattern strainers for water on supply side of water meters.
- D. Install water hammer arresters in water piping according to PDI-WH 201.
- E. Install air vents at high points of water piping.

### 3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping and specialties.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### 3.4 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.

END OF SECTION 221119





## SECTION 221316 - SANITARY WASTE AND VENT PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
- B. Field quality-control reports.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

#### 2.2 PIPING MATERIALS

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

#### 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.

- B. Gaskets: ASTM C 564, rubber.

## 2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and CISPI 310.
  - 2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Standards: ASTM C 1277 and ASTM C 1540.
  - 2. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

## 2.5 PVC PIPE AND FITTINGS

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F 656.
- E. Solvent Cement: ASTM D 2564.

## 2.6 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 2. Unshielded, Nonpressure Transition Couplings:
    - a. Standard: ASTM C 1173.
    - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.
    - d. Sleeve Materials:

- 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
  - 2) For Dissimilar Pipes: ASTM D 5926, or other material compatible with pipe materials being joined.
3. Shielded, Nonpressure Transition Couplings:
- a. Standard: ASTM C 1460.
  - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - c. End Connections: Same size as and compatible with pipes to be joined.

### PART 3 - EXECUTION

#### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

#### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.

- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- M. Install underground PVC piping according to ASTM D 2321.
- N. Plumbing Specialties:
  - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
  - 2. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- P. Install sleeves for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

- Q. Install sleeve seals for piping penetrations of concrete walls and slabs.
  - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors.
  - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in ODs.
- B. Check Valves: Install swing check valve, between pump and shutoff valve, on each pump discharge.

### 3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
  - 1. Install carbon-steel – galvanized pipe hangers for horizontal piping in noncorrosive environments.
  - 2. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  - 3. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 4. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  6. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1-1/2 and NPS 260 inches with 3/8-inch rod.
  2. NPS 360 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

### 3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

### 3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.



- a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
  - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
  - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
  - d. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.

### 3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 10 and smaller shall be the following:
  1. Service class, no-hub cast-iron soil pipe and fittings; medium or heavy duty gaskets
- C. Underground, soil, waste, and vent piping NPS 10 and smaller shall be the following:
  1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
  2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

## SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Roof flashing assemblies.
2. Miscellaneous sanitary drainage piping specialties.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

### PART 2 - PRODUCTS

#### 2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

#### 2.2 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch-thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
  - a. Open-Top Vent Cap: Without cap.
  - b. Low-Silhouette Vent Cap: With vandal-proof vent cap.
  - c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

## 2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

### B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

### D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

### E. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

### F. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install backwater valves in building drain piping.
  - 1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200, Sheet Metal Flashing and Trim.
- F. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof. Comply with requirements in Section 076200, Sheet Metal Flashing and Trim.
- G. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
  - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
  - 2. Size: Same as floor drain inlet.
- I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- J. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- K. Install vent caps on each vent pipe passing through roof.

- L. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- M. Install wood-blocking reinforcement for wall-mounting-type specialties.
- N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 FLASHING INSTALLATION

- A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
- B. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.
- C. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- D. Set flashing on floors and roofs in solid coating of bituminous cement.
- E. Secure flashing into sleeve and specialty clamping ring or device.
- F. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- G. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
  - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

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## SECTION 221429 - SUMP PUMPS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Submersible sump pumps.
  - 2. Sump covers.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's written rigging instructions for handling.



## PART 2 - PRODUCTS

### 2.1 SUBMERSIBLE SUMP PUMPS

#### A. Submersible, Fixed-Position, Single-Seal Sump Pumps:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
  - a. Bell & Gossett Domestic Pump; ITT Corporation.
  - b. Goulds Pumps; ITT Corporation.
  - c. Grundfos Pumps Corp.
  - d. Liberty Pumps.
  - e. Little Giant Pump Co.
  - f. Stancor, Inc.
  - g. Weil Pump Company, Inc.
  - h. Zoeller Company.

2. Description: Factory-assembled and -tested sump-pump unit.

### 2.2 MOTORS

- #### A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements.
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
- #### B. Motors for submersible pumps shall be hermetically sealed.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

### 3.2 INSTALLATION

- #### A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

### 3.3 CONNECTIONS

- #### A. Drawings indicate general arrangement of piping, fittings, and specialties.
- #### B. Install piping adjacent to equipment to allow service and maintenance.

### 3.4 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

#### B. Pumps and controls will be considered defective if they do not pass tests and inspections.

#### C. Prepare test and inspection reports.

### 3.5 STARTUP SERVICE

#### A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.6 ADJUSTING

#### A. Adjust pumps to function smoothly and lubricate as recommended by manufacturer.

#### B. Adjust control set points.

END OF SECTION 221429



## SECTION 224213.13 - COMMERCIAL WATER CLOSETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Water closets.
2. Flushometer valves.
3. Toilet seats.
4. Supports.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 WALL-MOUNTED WATER CLOSETS

A. Water Closets : Wall mounted, top spud.

1. Bowl:
  - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
  - b. Material: Vitreous china.
  - c. Type: Siphon jet.
  - d. Style: Flushometer valve.
  - e. Height: Standard.
  - f. Rim Contour: Elongated.
  - g. Water Consumption: 1.28 gal. per flush.
  - h. Spud Size and Location: NPS 1-1/2; top.

## 2.2 TOILET SEATS

### A. Toilet Seats :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. American Standard.
  - b. Bemis Manufacturing Company.
  - c. Centoco Manufacturing Corporation.
  - d. Church Seats; Bemis Manufacturing Company.
  - e. Jones Stephens Corp.
  - f. Kohler Co.
  - g. TOTO USA, INC.
  - h. Zurn Industries, LLC.
2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial Heavy duty.
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Not required.
9. Color: White.

## 2.3 SUPPORTS

### A. Water Closet Carrier:

## PART 3 - EXECUTION

### 3.1 INSTALLATION

#### A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.

#### B. Support Installation:

1. Use carrier supports with waste-fitting assembly and seal.
2. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.2 CONNECTIONS

- A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

### 3.3 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

3.4 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

## SECTION 224213.16 - COMMERCIAL URINALS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Urinals.
2. Flushometer valves.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 WALL-HUNG URINALS

A. Urinals : Wall hung, back outlet, siphon jet .

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. American Standard.
  - b. Briggs Plumbing Products, Inc.
  - c. Gerber Plumbing Fixtures LLC.
  - d. Kohler Co.
  - e. Mansfield Plumbing Products LLC.
  - f. Zurn Industries, LLC.

2. Fixture:



- a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
  - b. Material: Vitreous china.
  - c. Type: Siphon jet with extended shields.
  - d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
  - e. Water Consumption: Water saving.
  - f. Spud Size and Location: NPS 3/4; top.
  - g. Outlet Size and Location: NPS 2; back.
  - h. Color: White.
3. Waste Fitting:
  - a. Standard: ASME A112.18.2/CSA B125.2 for coupling.
  - b. Size: NPS 2.
4. Support: Type I Urinal Carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights..
5. Urinal Mounting Height: Standard and Handicapped/elderly according to ICC A117.1.

## 2.2 SUPPORTS

### A. Type I Urinal Carrier:

1. Standard: ASME A112.6.1M.
2. Standard: ASME A112.6.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

#### A. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.

5. Install trap-seal liquid in waterless urinals.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

### 3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

## SECTION 224216.13 - COMMERCIAL LAVATORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Lavatories.
2. Faucets.
3. Supports.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: Include diagrams for power, signal, and control wiring of automatic faucets.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Servicing and adjustments of automatic faucets.

### PART 2 - PRODUCTS

#### 2.1 VITREOUS-CHINA, COUNTER-MOUNTED LAVATORIES

- A. Lavatory: Oval, vitreous china, undercounter mounted.
  1. Fixture:

- a. Standard: ASME A112.19.2/CSA B45.1.
- b. Type: For undercounter mounting.
- c. Faucet-Hole Punching: No holes.
- d. Faucet-Hole Location: On countertop.
- e. Color: White.
- f. Mounting Material: Sealant and undercounter mounting kit.

## 2.2 SOLID-BRASS, SENSOR OPERATED FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet materials that will be in contact with potable water.
- B. Lavatory Faucets: Battery operated, single-control mixing commercial, solid-brass valve.
  1. Standard: ASME A112.18.1/CSA B125.1.
  2. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
  3. Body Type: Single hole.
  4. Body Material: Commercial, solid brass.
  5. Finish: Polished chrome plate.
  6. Maximum Flow: 0.25 gal. per metering cycle.
  7. Mounting Type: Deck, exposed.
  8. Spout: Rigid type.
  9. Spout Outlet: Aerator.
  10. Drain: Not part of faucet.

## 2.3 SUPPORTS

- A. Type II Lavatory Carrier:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Jay R. Smith Mfg Co; a division of Morris Group International.
    - b. Josam Company.
    - c. MIFAB, Inc.
    - d. Wade Drains.
    - e. WATTS.
    - f. Zurn Industries, LLC.
  2. Standard: ASME A112.6.1M.
- B. Type III Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Wade Drains.
  - e. WATTS.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.6.1M.

#### 2.4 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  1. NPS 3/8.
  2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

#### 2.5 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
  1. Size: NPS 1-1/4.
  2. Material: Chrome-plated, one-piece, cast-brass trap with swivel 0.029-inch-thick tubular brass wall bend; and chrome-plated, brass or steel wall flange.
  3. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch-thick stainless-steel tube to wall; and stainless-steel wall flange.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.
- B. Examine counters and walls for suitable conditions where lavatories will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install lavatories level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, according to ICC/ANSI A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories and counters and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

#### 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

#### 3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.

- B. Adjust water pressure at faucets to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

### 3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13



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## SECTION 224216.16 - COMMERCIAL SINKS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Sinks
2. Sink faucets.
3. Laminar-flow, faucet-spout outlets.
4. Supply fittings.
5. Waste fittings.
6. Supports.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

##### A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted lavatories.

#### 1.4 CLOSEOUT SUBMITTALS

##### A. Maintenance data.

### PART 2 - PRODUCTS

#### 2.1 SINKS

##### A. Refer to the drawings for sink, faucet and connecting trim specifications.

1. Sink Faucets" Article.
2. Waste Fittings:
  - a. Standard: ASME A112.18.2/CSA B125.2.

## 2.2 SINK FAUCETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout materials that will be in contact with potable water.

## 2.3 LAMINAR-FLOW, FAUCET-SPOUT OUTLETS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for faucet-spout-outlet materials that will be in contact with potable water.
- B. Description: Chrome-plated brass, faucet-spout outlet that produces non-aerating, laminar stream. Include external or internal thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

## 2.4 SUPPORTS

- A. Type II Sink Carrier:
  - 1. Standard: ASME A112.6.1M.

## 2.5 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF/ANSI 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose key.
- F. Risers:
  - 1. NPS 3/8.
  - 2. ASME A112.18.6, braided or corrugated stainless-steel flexible hose.

## 2.6 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install sinks level and plumb according to roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
  - 1. Exception: Use ball valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping".
  - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

### 3.3 CONNECTIONS

- A. Connect sinks with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

#### 3.4 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow.

#### 3.5 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

## SECTION 224716 - PRESSURE WATER COOLERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes pressure water coolers and related components.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of pressure water cooler.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For pressure water coolers to include in maintenance manuals.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

### PART 2 - PRODUCTS

#### 2.1 PRESSURE WATER COOLERS

- A. Pressure Water Coolers Flush to wall. Refer to the plumbing fixture schedule for the fixture number and specification.
  - 1. Support: Support can provided with the electric water cooler.
  - 2. Water Cooler Mounting Height: Standard and Handicapped/elderly according to ICC A117.1.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping".
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

### 3.3 CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping".
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

### 3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust pressure water-cooler temperature settings.

3.5 CLEANING

- A. After installing fixture, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224716



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## SECTION 230500 - COMMON WORK RESULTS FOR HVAC

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Motors.
2. Sleeves without waterstop.
3. Stack-sleeve fittings.
4. Sleeve-seal systems.
5. Grout.
6. Silicone sealants.
7. Escutcheons.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data:

1. For each type of product, excluding motors which are included in Part 1 of HVAC equipment Sections.
  - a. Include construction details, material descriptions, and dimensions of individual components, and finishes.
  - b. Include operating characteristics and furnished accessories.

#### 1.3 COORDINATION

- ##### A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
1. Motor controllers.
  2. Torque, speed, and horsepower requirements of the load.
  3. Ratings and characteristics of supply circuit and required control sequence.
  4. Ambient and environmental conditions of installation location.

### PART 2 - PRODUCTS

#### 2.1 MOTORS

##### A. Motor Requirements, General:

1. Content includes motors for use on alternating-current power systems of up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.
2. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.
3. Comply with NEMA MG 1 unless otherwise indicated.
4. Comply with IEEE 841 for severe-duty motors.

B. Motor Characteristics:

1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 ft. above sea level.
2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

C. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Premium Efficient, as defined in NEMA MG 1.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.
  - a. For motors with 2:1 speed ratio, consequent pole, single winding.
  - b. For motors with other than 2:1 speed ratio, separate winding for each speed.
5. Multispeed Motors, Two Winding: Separate winding for each speed.
6. Rotor: Random-wound, squirrel cage.
7. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
8. Temperature Rise: Match insulation rating.
9. Insulation: Class F .
10. Code Letter Designation:
  - a. Motors 15 Hp and Larger: NEMA starting Code F or Code G.
  - b. Motors Smaller Than 15 Hp: Manufacturer's standard starting characteristic.
11. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T .

D. Additional Requirements for Polyphase Motors:

1. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
2. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

- a. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time-rise pulses produced by pulse-width-modulated inverters.
  - b. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - c. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - d. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
3. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

E. Single-Phase Motors:

1. Motors larger than 1/20 hp must be one of the following, to suit starting torque and requirements of specific motor application:
  - a. Permanent-split capacitor.
  - b. Split phase.
  - c. Capacitor start, inductor run.
  - d. Capacitor start, capacitor run.
2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
4. Motors 1/20 hp and Smaller: Shaded-pole type.
5. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device will automatically reset when motor temperature returns to normal range.

F. Electronically Commutated Motors:

1. Microprocessor-Based Electronic Control Module: Converts 120 V or 240 V single-phase AC power to three-phase DC power to operate the brushless DC motor.
2. Three-phase power motor module with permanent magnet rotor.
3. Circuit board or digital speed controller/LED display.
4. Building Automation System Interface: Via AC voltage signal, DC voltage signal or Digital Serial Interface (DSI).

2.2 SLEEVES AND SLEEVE SEALS

A. Sleeves without Waterstop:

1. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron, with plain ends.
2. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
3. Steel Sheet Sleeves: ASTM A653/A653M, 24 gauge minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.

4. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange.
- B. Sleeves with Waterstop:
1. Description: Manufactured PVC/HDPE, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
- C. Sleeve-Seal Systems:
1. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
    - a. Hydrostatic seal: 20 psig.
    - b. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
    - c. Pressure Plates: Carbon steel.
    - d. Connecting Bolts and Nuts: Carbon steel, with zinc coating. ASTM B633 of length required to secure pressure plates to sealing elements.
- D. Grout:
1. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
  2. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
  3. Design Mix: 5000 psi, 28-day compressive strength.
  4. Packaging: Premixed and factory packaged.
- E. Silicone Sealants:
1. Silicone Sealant, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
    - a. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.
  2. Silicone Sealant, S, P, T, NT: Single-component, **25**, pourable, **plus 25 percent and minus 25 percent** movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
    - a. Standard: ASTM C920, Type S, Grade P, **Class 25**, Uses T and NT.
  3. Silicone Foam Sealant: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## 2.3 ESCUTCHEONS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. BrassCraft Manufacturing Co.; a Masco company.
  2. Dearborn Brass.
  3. Jones Stephens Corp.
  4. Keeney Manufacturing Company (The).
  5. Mid-America Fittings, LLC; A Midland Industries Company.
  6. ProFlo; a Ferguson Enterprises, Inc. brand.
- B. Escutcheon Types:
1. One-Piece, Steel Type: With **polished, chrome-plated** finish and setscrew fastener.
  2. One-Piece, Stainless Steel Type: With polished stainless steel finish.
  3. One-Piece, Cast-Brass Type: With **polished, chrome-plated** finish and setscrew fastener.
  4. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped **steel** with polished, chrome-plated finish and spring-clip fasteners.
  5. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
  6. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; **concealed** hinge; and spring-clip fasteners.
- C. Floor Plates:
1. Split Floor Plates: Steel with concealed hinge.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PIPE LOOPS AND SWING CONNECTIONS

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

### 3.2 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout or silicone sealant, seal space outside of sleeves in floors/slabs/walls without sleeve-seal system. Select to maintain fire resistance of floor/slab/wall.
- D. Install sleeves for pipes passing through interior partitions.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
  - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants that joint sealant manufacturer's literature indicates is appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

### 3.3 INSTALLATION OF SLEEVES WITH WATERSTOP

- A. Install sleeve with waterstop as new walls and slabs are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange centered across width of concrete slab or wall.
- C. Secure nailing flanges to wooden concrete forms.
- D. Using grout or silicone sealant, seal space around outside of sleeves.

### 3.4 INSTALLATION OF STACK-SLEEVE FITTINGS

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
  - 1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  - 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
  - 3. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
  - 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 5. Using silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

### 3.5 INSTALLATION OF SLEEVE-SEAL SYSTEMS

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building, and passing through exterior walls.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.6 FIELD QUALITY CONTROL

- A. Sleeves and Sleeve Seals:
  - 1. Perform the following tests and inspections:
    - a. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
    - b. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

### 3.7 SLEEVES APPLICATION

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above and below Grade:



- a. Sleeves with waterstops.
  - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- 2. Concrete Slabs-on-Grade:
  - a. Sleeves with waterstops.
    - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
- 3. Concrete Slabs above Grade:
  - a. Sleeves with waterstops or stack-sleeve fittings.
- 4. Interior Walls and Partitions:
  - a. Sleeves without waterstops.

END OF SECTION 230500

## SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment stands.
8. Equipment supports.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230500 "Common Work Results for HVAC" for pipe guides and anchors.
3. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.
4. Section 233113 "Metal Ducts" for duct hangers and supports.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated Design Submittals: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

### 1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment.

### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Copper Pipe and Tube Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel or stainless steel.

## 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

## 2.4 PLASTIC PIPE HANGERS

- A. Description: Similar to MSS SP-58, Types 1 through 58, factory-fabricated steel pipe hanger except hanger is made of plastic.
- B. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
- C. Flammability: ASTM D635, ASTM E84, and UL 94.

## 2.5 METAL FRAMING SYSTEMS

### A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
7. Metallic Coating: No coating.

### B. Non-MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Select for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
7. Metallic Coating: No coating.

## 2.6 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psi, ASTM C552, Type II cellular glass with 100-psi or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psi minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.7 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Indoor Applications: Zinc-coated or stainless steel.
  - 2. Outdoor Applications: Stainless steel.

## 2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.9 OUTDOOR EQUIPMENT STANDS

- A. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground or roof supported outdoor equipment components, without roof membrane penetration, in a pre-fabricated system that can be modularly-assembled on site.
- B. Foot Material: Rubber or polypropylene.
- C. Rails Material: Hot dip galvanized carbon steel.
- D. Wind/Sliding Load Resistance: Up to 100 mph minimum.

## 2.10 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.
- F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry 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.

### 3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

- C. Framing System Installation: Metal. Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
  - 1. Attach clamps and spacers to piping.

- a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
  - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
  - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
  - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - a. Thermal-hanger shield inserts may be used as an option. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches long and 0.048 inch thick.
  - b. NPS 4 (DN 100): 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 INSTALLATION OF EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.



- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touchup:
  - 1. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
  - 2. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use stainless steel pipe hangers and stainless steel attachments for hostile environment applications.

- G. Use copper-plated pipe hangers and copper or stainless steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  - 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
  - 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529



## SECTION 230546 - COATINGS FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. General provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes application of coating systems on internal HVAC components and external equipment surfaces, including the following systems:
  - 1. Bake-cured corrosion-resistant coating systems.
  - 2. Air-dried corrosion-resistant coating systems.

#### 1.3 DEFINITIONS

- A. Salt Water Acetic Acid Test (SWAAT): A salt fog-spray test of corrosion resistance performed in accordance with ASTM G85, Annex 3.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include Safety Data Sheets, preparation requirements, and application instructions.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Source Quality-Control Reports:
  - 1. Certification of coating material testing.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Coatings: 1container of each material and color applied, including base coat and top coat products.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in clean, dry, well-ventilated areas with ambient temperatures continuously maintained between 50 and 75 deg F.
  - 1. Keep containers out of direct sunlight; avoid excessive heat and keep from freezing.
  - 2. Maintain containers in clean condition, free of foreign materials and residue.
  - 3. Remove rags and waste from storage areas daily.

1.8 CONDITIONS FOR COATING APPLICATION

- A. Comply with manufacturer's recommendations regarding required temperature and humidity ranges during coating application.

PART 2 - PRODUCTS

2.1 CORROSION-RESISTANT COATING SYSTEMS, GENERAL

- A. Material Compatibility:
  - 1. Provide materials for application within each coating system that are compatible with one another and with metal substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coating material in coating system, submit compatibility certification from manufacturer of each coating product that products are compatible with substrate base material and with substrate-coating products applied as earlier coats.
  - 3. Products shall be of same manufacturer for each coat in a coating system.
- B. Colors: Manufacturer's standard.

2.2 BAKE-CURED CORROSION-RESISTANT COATING SYSTEMS

- A. Base Coat Performance Requirements:
  - 1. Corrosion Resistance: ASTM B117: 3000 hours.

2.3 AIR-DRIED CORROSION-RESISTANT COATING SYSTEMS

- A. Performance Requirements:
  - 1. Corrosion Resistance: ASTM B117: 3000 hours.
- B. Base Coat Performance Requirements:
  - 1. Corrosion Resistance: ASTM B117: 3000 hours.

- C. Air-Dried Top Coat Performance Requirements: Provide product with UV shielding properties, color stability, and maintenance of manufacturer's standard sheen, after exposure to outdoor conditions.
- D. Spray-Can Application Systems:
  - 1. Type: Air dry, phenolic.

## 2.4 SOURCE QUALITY CONTROL

- A. Certification of Coating Material Testing: Submit manufacturer's test report of corrosion-resistance performance testing, as performed by a nationally recognized testing laboratory.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with coating manufacturer's requirements and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and coating systems indicated.
  - 1. Thinning: Thin coating material with manufacturer's recommended thinning products when recommended or permitted by coating system manufacturer.
- B. Comply with coating system manufacturer's recommendations to clean substrates of substances that could impair bond of coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

### 3.3 APPLICATION

- A. Verify with coating manufacturer whether coatings required must be applied and cured in factory-certified application shop.



- B. Apply coating systems with equipment designed to deposit coating of specified uniform thickness over HVAC components, in complex, three-dimensional geometries.
  - 1. Apply coatings with manufacturer-recommended tools and techniques suited for specified coating system and each coated HVAC component.
  - 2. Do not apply coatings over labels or equipment name, identification, performance rating, or nomenclature plates.
- C. Perform inspection and coating system manufacturer's recommended tests to verify coating integrity and thickness. Where coating was damaged by testing, repair damage in accordance with coating system manufacturer's written recommendations.

END OF SECTION 230546

## SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Stencils.
6. Warning tags.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve-numbering scheme.
- D. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Carlton Industries, LP.
  - c. Champion America.
  - d. Craftmark Pipe Markers.
  - e. Kolbi Pipe Marker Co.
  - f. LEM Products Inc.
  - g. Marking Services Inc.
  - h. Pipemarket.com; Brimar Industries, Inc.

- i. Seton Identification Products; a Brady Corporation company.
  - j. emedco.
2. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Brady Corporation.
  - b. Carlton Industries, LP.
  - c. Champion America.
  - d. Craftmark Pipe Markers.
  - e. Kolbi Pipe Marker Co.
  - f. LEM Products Inc.
  - g. Marking Services Inc.
  - h. Pipemarker.com; Brimar Industries, Inc.
  - i. Seton Identification Products; a Brady Corporation company.
  - j. emedco.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

## 2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Carlton Industries, LP.
  - 3. Champion America.
  - 4. Craftmark Pipe Markers.
  - 5. LEM Products Inc.
  - 6. Marking Services Inc.
  - 7. National Marker Company.
  - 8. Pipemarker.com; Brimar Industries, Inc.
  - 9. Seton Identification Products; a Brady Corporation company.
  - 10. Stranco, Inc.
  - 11. emedco.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-taping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.
- J. Label Content: Include caution and warning information plus emergency notification instructions.

## 2.3 WARNING TAPE

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

1. Brady Corporation.
2. Craftmark Pipe Markers.
3. National Marker Company.
4. Pipemarker.com; Brimar Industries, Inc.
5. Seton Identification Products; a Brady Corporation company.

- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch.
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F.
- G. Minimum Width: 4 inches.

## 2.4 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Actioncraft Products, Inc.; a division of Industrial Test Equipment Co., Inc.
  2. Brady Corporation.
  3. Carlton Industries, LP.
  4. Champion America.
  5. Craftmark Pipe Markers.
  6. Kolbi Pipe Marker Co.
  7. LEM Products Inc.
  8. Marking Services Inc.
  9. Pipemarker.com; Brimar Industries, Inc.
  10. Seton Identification Products; a Brady Corporation company.
  11. emedco.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
1. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. .

## 2.5 STENCILS

### A. Stencils for Piping:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Craftmark Pipe Markers.
  - b. Kolbi Pipe Marker Co.
  - c. Marking Services Inc.
  - d. Pipemarker.com; Brimar Industries, Inc.
2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
3. Stencil Material: Aluminum, brass, or fiberboard.
4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.
6. Letter and Background Color: As indicated for specific application under Part 3.

### B. Stencils for Ducts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Craftmark Pipe Markers.
  - b. Kolbi Pipe Marker Co.
  - c. Marking Services Inc.
  - d. Pipemarker.com; Brimar Industries, Inc.
2. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances of up to 15 ft. and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
6. Letter and Background Color: Color as indicated for specific application under Part 3.

### C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Craftmark Pipe Markers.
  - b. Kolbi Pipe Marker Co.
  - c. Marking Services Inc.
  - d. Pipemarker.com; Brimar Industries, Inc.
2. Lettering Size: Minimum letter height of 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.
6. Letter and Background Color: As indicated for specific application under Part 3.

## 2.6 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Brady Corporation.
  2. Champion America.
  3. Craftmark Pipe Markers.
  4. Kolbi Pipe Marker Co.
  5. LEM Products Inc.
  6. Marking Services Inc.
  7. Pipemarker.com; Brimar Industries, Inc.
  8. Seton Identification Products; a Brady Corporation company.
  9. emedco.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  1. Size: 3 by 5-1/4 inches minimum.
  2. Fasteners: Brass grommet and wire.
  3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Letter and Background Color: As indicated for specific application under Part 3.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

### 3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

- D. Locate identifying devices so that they are readily visible from the point of normal approach.

### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of mechanical equipment.
- B. Sign and Label Colors:
  - 1. White letters on an ANSI Z535.1 safety-blue background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

### 3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

### 3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Within 3 ft. of each valve and control device.
  - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 3. Within 3 ft. of equipment items and other points of origination and termination.



4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.
- E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- F. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- G. Pipe-Label Color Schedule:
  1. Steam Condensate Piping: White letters on an ANSI Z535.1 safety-green background.
  2. Potable and Other Water: White letters on an ANSI Z535.1 safety-green background.

### 3.6 INSTALLATION OF DUCT LABELS

- A. Install self-adhesive duct labels showing service and flow direction with permanent adhesive on air ducts.
  1. Provide labels in the following color codes:
    - a. For air supply ducts: White letters on blue background.
    - b. For air return ducts: White letters on blue background.
    - c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on blue background.
- B. Stenciled Duct-Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
  1. For all air ducts: Black letters on white background.
- C. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 20 ft. where exposed or are concealed by removable ceiling system.
- D. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
  1. Black letters on White background.

### 3.7 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.

1. Valve-Tag Size and Shape:

- a. Refrigerant: 1-1/2 inches, round.

2. Valve-Tag Colors:

- a. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

3.8 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where scheduled.

END OF SECTION 230553



## SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Testing, Adjusting, and Balancing of Air Systems:
  - a. Constant-volume air systems.
  - b. Multizone systems.
2. Testing, adjusting, and balancing of equipment.
3. Duct leakage tests verification.
4. Pipe leakage tests verification.
5. HVAC-control system verification.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

#### 1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB or TABB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."
- E. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

## 1.6 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.
- F. Examine equipment performance data, including fan curves.
  - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- L. Examine system pumps to ensure absence of entrained air in the suction piping.
- M. Examine operating safety interlocks and controls on HVAC equipment.
- N. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.
- O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Airside:
    - a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
    - b. Duct systems are complete with terminals installed.
    - c. Volume, smoke, and fire dampers are open and functional.
    - d. Clean filters are installed.
    - e. Fans are operating, free of vibration, and rotating in correct direction.
    - f. Variable-frequency controllers' startup is complete and safeties are verified.
    - g. Automatic temperature-control systems are operational.
    - h. Ceilings are installed.
    - i. Windows and doors are installed.
    - j. Suitable access to balancing devices and equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

- B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
  - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

### 3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

- A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Fans and ventilators.
  - 2. Dedicated outdoor-air units.
  - 3. Variable-refrigerant-flow systems.

### 3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' Record drawings duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.



- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.

### 3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    - b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    - c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
  - 2. Measure fan static pressures as follows:
    - a. Measure static pressure directly at the fan outlet or through the flexible connection.
    - b. Measure static pressure directly at the fan inlet or through the flexible connection.
    - c. Measure static pressure across each component that makes up the air-handling system.
    - d. Report artificial loading of filters at the time static pressures are measured.
  - 3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
  - 5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.
  - 1. Measure airflow of submain and branch ducts.
  - 2. Adjust submain and branch duct volume dampers for specified airflow.
  - 3. Re-measure each submain and branch duct after all have been adjusted.
- C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

### 3.7 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

### 3.8 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

- A. Verify proper rotation of fan(s).
- B. Measure and record entering- and leaving-air temperatures.
- C. Measure and record entering and leaving refrigerant pressures.
- D. Measure and record operating data of compressor(s), fan(s), and motors.

### 3.9 DUCT LEAKAGE TESTS

- A. Witness the duct leakage testing performed by Installer.

- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

### 3.10 PIPE LEAKAGE TESTS

- A. Witness the pipe pressure testing performed by Installer.
- B. Verify that proper test methods are used and that leakage rates are within specified limits.
- C. Report deficiencies observed.

### 3.11 HVAC CONTROLS VERIFICATION

- A. In conjunction with system balancing, perform the following:
  - 1. Verify HVAC control system is operating within the design limitations.
  - 2. Confirm that the sequences of operation are in compliance with Contract Documents.
  - 3. Verify that controllers are calibrated and function as intended.
  - 4. Verify that controller set points are as indicated.
  - 5. Verify the operation of lockout or interlock systems.
  - 6. Verify the operation of valve and damper actuators.
  - 7. Verify that controlled devices are properly installed and connected to correct controller.
  - 8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
  - 9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.
- B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

### 3.12 TOLERANCES

- A. Set HVAC system's airflow rates and water flow rates within the following tolerances:
  - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
  - 2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
- B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

### 3.13 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.14 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Fan curves.
  - 2. Manufacturers' test data.
  - 3. Field test reports prepared by system and equipment installers.
  - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents, including the following:
    - a. Indicated versus final performance.

- b. Notable characteristics of systems.
  - c. Description of system operation sequence if it varies from the Contract Documents.
- 12. Nomenclature sheets for each item of equipment.
- 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
- 14. Notes to explain why certain final data in the body of reports vary from indicated values.
- 15. Test conditions for fans performance forms, including the following:
  - a. Settings for outdoor-, return-, and exhaust-air dampers.
  - b. Conditions of filters.
  - c. Cooling coil, wet- and dry-bulb conditions.
  - d. Heating coil, dry-bulb conditions.
  - e. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
  - 1. Quantities of outdoor, supply, return, and exhaust airflows.
  - 2. Duct, outlet, and inlet sizes.
  - 3. Terminal units.
  - 4. Balancing stations.
  - 5. Position of balancing devices.
- E. Apparatus-Coil Test Reports:
  - 1. Coil Data:
    - a. System identification.
    - b. Location.
    - c. Coil type.
    - d. Number of rows.
    - e. Fin spacing in fins per inch o.c.
    - f. Make and model number.
    - g. Face area in sq. ft..
    - h. Tube size in NPS.
    - i. Tube and fin materials.
    - j. Circuiting arrangement.
  - 2. Test Data (Indicated and Actual Values):
    - a. Airflow rate in cfm.
    - b. Average face velocity in fpm.
    - c. Air pressure drop in inches wg.
    - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
    - e. Refrigerant expansion valve and refrigerant types.
    - f. Refrigerant suction pressure in psig.
    - g. Refrigerant suction temperature in deg F.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Center-to-center dimensions of sheave and amount of adjustments in inches.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and speed.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave and amount of adjustments in inches.
  - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
  - a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan speed.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
  - a. System fan and air-handling-unit number.
  - b. Location and zone.
  - c. Traverse air temperature in deg F.
  - d. Duct static pressure in inches wg.
  - e. Duct size in inches.
  - f. Duct area in sq. ft..
  - g. Indicated airflow rate in cfm.
  - h. Indicated velocity in fpm.
  - i. Actual airflow rate in cfm.
  - j. Actual average velocity in fpm.
  - k. Barometric pressure in psig.

H. Air-Terminal-Device Reports:

1. Unit Data:
  - a. System and air-handling unit identification.
  - b. Location and zone.
  - c. Apparatus used for test.
  - d. Area served.
  - e. Make.
  - f. Number from system diagram.
  - g. Type and model number.
  - h. Size.
  - i. Effective area in sq. ft..
2. Test Data (Indicated and Actual Values):
  - a. Airflow rate in cfm.
  - b. Air velocity in fpm.
  - c. Preliminary airflow rate as needed in cfm.
  - d. Preliminary velocity as needed in fpm.
  - e. Final airflow rate in cfm.
  - f. Final velocity in fpm.
  - g. Space temperature in deg F.

### 3.15 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
- B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
  1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
  2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

F. Prepare test and inspection reports.

END OF SECTION 230593





## SECTION 230713 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes insulating the following duct services:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return located in unconditioned space.
  - 4. Indoor, exposed return located in unconditioned space.
  - 5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
- B. Related Requirements:
  - 1. Section 230716 "HVAC Equipment Insulation."
  - 2. Section 230719 "HVAC Piping Insulation."
  - 3. Section 233113 "Metal Ducts" for duct liners.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
  - 3. Detail application of field-applied jackets.
  - 4. Detail application at linkages of control devices.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers are to be marked with the manufacturer's name, appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

## 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials are to be applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534, Type II for sheet materials.
- G. Glass-Fiber Blanket: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 450 deg F in accordance with ASTM C411. Comply with ASTM C553, Type II, and ASTM C1290, Type I, unfaced. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- H. Mineral Wool Blanket: Basalt volcanic rock-derived fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C553.
- I. Glass-Fiber Board Insulation: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature between 35 deg F and 250 deg F for jacketed and between 35 deg F and 450 deg F for unfaced in accordance with ASTM C411. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation unfaced. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Mineral Wool Board: Basalt volcanic rock-derived fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 1100 deg F in accordance with ASTM C411. Comply with ASTM C612, Type III, unfaced.
- K. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

## 2.3 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- C. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.

## 2.4 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based, Interior Use: Suitable for indoor use on below ambient services.
  - 1. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Color: White.

## 2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and are compatible with insulation materials, jackets, and substrates.
  - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
  - 2. Service Temperature Range: 0 to plus 180 deg F.
  - 3. Color: White.

## 2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Materials are compatible with insulation materials, jackets, and substrates.
  - 2. Fire- and water-resistant, flexible, elastomeric sealant.
  - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Materials are compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested in accordance with ASTM E96/E96M, Procedure A, and complying with NFPA 90A and NFPA 90B.
6. ASJ+: All-service jacket composed of aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
7. PSK Jacket: Aluminum foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Adhesive: As recommended by jacket material manufacturer.
  2. Color: White.
- D. Metal Jacket:
1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing.

- b. Finish and thickness are indicated in field-applied jacket schedules.
      - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
      - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    2. Stainless Steel Jacket: ASTM A240/A240M.
      - a. Sheet and roll stock ready for shop or field sizing.
      - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
      - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  - E. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.
  - F. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket has five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.
    1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
    2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
    3. Aluminum Finish: Embossed.
- 2.9 TAPES
- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
    1. Width: 3 inches.
    2. Thickness: 11.5 mils.
    3. Adhesion: 90 ounces force/inch in width.
    4. Elongation: 2 percent.
    5. Tensile Strength: 40 lbf/inch in width.
    6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
  - B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
    1. Width: 3 inches.
    2. Thickness: 6.5 mils.
    3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Width: 2 inches.
  2. Thickness: 6 mils.
  3. Adhesion: 64 ounces force/inch in width.
  4. Elongation: 500 percent.
  5. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
  2. Thickness: 3.7 mils.
  3. Adhesion: 100 ounces force/inch in width.
  4. Elongation: 5 percent.
  5. Tensile Strength: 34 lbf/inch in width.

## 2.10 SECUREMENTS

### A. Bands:

1. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal or closed seal.
2. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.



- b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
      - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
    - 4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      - a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
      - b. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
      - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
    - 5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
      - a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
      - b. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
      - c. Adhesive-backed base with a peel-off protective cover.
    - 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
      - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
    - 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
  - D. Wire: 0.080-inch nickel-copper alloy.
- 2.11 CORNER ANGLES
- A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum in accordance with ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  - 1. Verify that systems to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

#### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
1. Comply with requirements in Section 078413 "Penetration Firestopping."
- E. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
- 3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC AND POLYOLEFIN INSULATION
- A. Comply with manufacturer's written installation instructions and ASTM C1710.
- B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Square and Rectangular Ducts and Plenums:
1. Provide 1/4 inch more per side for a tight, compression fit.
  2. Cut sheet insulation with the following dimensions:
    - a. Width of duct plus 1/4 inch, one piece.
    - b. Height of duct plus 1/4 inch, plus thickness of insulation, two pieces.
    - c. Width of duct plus 1/4 inch, plus two times the thickness of insulation, one piece.

3. Insulate the bottom of the duct with the sheet from (a) above, then the sides with the two sheets from (b) above, and finally the top of the duct with the sheet from (c) above.
4. Insulation without self-adhering backing:
  - a. Apply 100 percent coverage of manufacturer adhesive on the metal surface, then the insulation, except for the last 1/4 inch where sheets will butt together.
  - b. Roll sheet down into position.
  - c. Press two sheets together under compression and apply adhesive at the butt joint to seal the two sheets together.
5. Insulation with self-adhering backing:
  - a. Peel back release paper in 6- to 8-inch increments and line up sheet.
  - b. Press firmly to activate adhesive.
  - c. Align material and continue to line up correctly, pressing firmly while slowly removing release paper.
  - d. Allow 1/4-inch overlap for compression at butt joints.
  - e. Apply adhesive at the butt joint to seal the two sheets together.
6. Insulate duct brackets following manufacturer's written installation instructions.

D. Circular Ducts:

1. Determine the circumference of the duct, using a strip of insulation the same thickness as to be used.
2. Cut the sheet to the required size.
3. Apply 100 percent coverage of manufacturer adhesive on the metal surface then the insulation.
4. Apply manufacturer adhesive to the cut surfaces along 100 percent of the longitudinal seam. Press together the seam at the ends and then the middle. Close the entire seam starting from the middle.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL-WOOL INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
- B. Comply with manufacturer's written installation instructions.
  1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.8 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

### 3.9 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
1. Indoor, concealed supply and outdoor air.
  2. Indoor, exposed supply and outdoor air.
  3. Indoor, concealed return located in unconditioned space.
  4. Indoor, exposed return located in unconditioned space.
  5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
  6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.



B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air duct and outdoor air insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Mineral Wool Blanket: 1-1/2 inches thick and 4 lb/cu. ft. nominal density.
4. Polyolefin: 1 inch thick.

B. Exposed, round and flat-oval, supply-air duct insulation is one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Glass-Fiber Blanket: 2 inches thick and 1.5 lb/cu. ft. nominal density.
3. Polyolefin: 1 inch thick.

END OF SECTION 230713

## SECTION 230800 - COMMISSIONING OF HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes Cx process requirements for the following HVAC systems, assemblies, and equipment:
  - 1. Air distribution systems.
  - 2. Heating and cooling terminal and unitary equipment.
  - 3. HVAC controls.
  - 4. TAB verification.
- B. Related Requirements:
  - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
  - 2. For construction checklists, comply with requirements in various Division 23 Sections specifying HVAC systems, system components, equipment, and products.

#### 1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- D. IgCC: International Green Construction Code.
- E. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they mean "as-built" systems, assemblies, subsystems, equipment, and components.
- F. TAB: Testing, adjusting, and balancing.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For BAS and HVAC testing technician.
- B. Construction Checklists:
  - 1. Draft Cx plan, including draft construction checklists to be prepared by CxA under Section 019113 "General Commissioning Requirements." Div. 23 Subcontractor is to review Construction Checklist in accordance with requirements in Section 019113 "General Commissioning Requirements" and ASHRAE 202 and to resolve any issues with the CxA.
  - 2. Cx plan, including material, installation, and performance construction checklists for systems, assemblies, subsystems, equipment, and components relating to BAS and HVAC to be part of the Cx process and in accordance with requirements in Section 019113 "General Commissioning Requirements and ASHRAE 202."
- C. Test Equipment and Instruments: For all test equipment and instruments to be used in conducting Cx tests by Div. 23 Subcontractor, provide the following:
  - 1. Equipment/instrument identification number.
  - 2. Planned Cx application or use.
  - 3. Manufacturer, make, model, and serial number.
  - 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
  - 5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:
    - a. Instrument or tool identification number.
    - b. Equipment schedule designation of equipment for which the instrument or tool is required.
    - c. Manufacturer, make, model, and serial number.
    - d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

#### 1.5 QUALITY ASSURANCE

- A. BAS Testing Technician Qualifications: Technicians performing BAS Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations are to have the following minimum qualifications:
  - 1. Journey level or equivalent skill level with knowledge of BAS, HVAC, electrical concepts, and building operations.
  - 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
  - 3. International Society of Automation (ISA)-Certified Control Systems Technician (CCST) Level I.

- B. HVAC Testing Technician Qualifications: Technicians to perform HVAC Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
1. Journey level or equivalent skill level; vocational school four-year-program graduate or an Associate's degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC equipment, assemblies, and systems.
  2. Minimum three years' experience that is to include installing, servicing, and operating systems manufactured by approved manufacturer.
- C. Testing Equipment and Instrumentation Quality and Calibration:
1. Capable of testing and measuring performance within the specified acceptance criteria.
  2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
  3. Be maintained in good repair and operating condition throughout duration of use on Project.
  4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- D. Proprietary Test Instrumentation and Tools:
1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
    - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
    - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
  2. HVAC proprietary test instrumentation and tools become property of Owner at the time of Final Acceptance.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 Cx PROCESS:

- A. Perform Cx process in accordance with Section 019113 "General Commissioning Requirements" for BAS and HVAC and in accordance with the following:

1. Commissioning standards acceptable to the authority having jurisdiction.

### 3.2 CONSTRUCTION CHECKLISTS

- A. Preliminary detailed construction checklists are to be prepared under Section 019113 "General Commissioning Requirements" for each BAS and HVAC system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in ASHRAE 202. Contractor performs the following:
  1. Review BAS and HVAC preliminary construction checklists and provide written comments on checklist items where appropriate.
  2. Return preliminary Construction Checklist with review comments within 10 days of receipt.
  3. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
  4. Use only construction checklists marked "Approved for Use, (date)" When performing tests. Mark construction checklists in the appropriate place as indicated Project events are completed, and provide pertinent details and other information.
- B. Prepare preliminary detailed construction checklists for each BAS and HVAC system, assembly, subsystem, equipment, and component required to be commissioned, as detailed in ASHRAE 202.
  1. Submit preliminary construction checklists to CxA and Designer for review.
  2. When review comments have been resolved, the CxA will provide final construction checklists marked "Approved for Use, (date)."
  3. Use only construction checklists, marked "Approved for Use, (date)" when performing tests. Mark construction checklists in the appropriate place, as indicated Project events are completed and provide pertinent details and other information.
- C. Additional systems required to be commissioned:
  1. Air-handling systems, including the following:
    - a. Supply, return, and exhaust air fans, motors, and drives.
    - b. Automatic and gravity dampers.
    - c. Heating and cooling devices.
    - d. Humidification and dehumidification devices.
    - e. Air filters.
    - f. Hangers and supports.
  2. Air duct systems, including the following:
    - a. Duct systems.
    - b. Air-duct accessories, including volume dampers, fire and smoke dampers, turning vanes, sound attenuators, and flexible connectors.
    - c. Duct-mounted access doors and panels.
    - d. Hangers and supports.

3. Refrigerant piping, including the following:
  - a. Refrigerant piping, fittings, and specialties.
  - b. Refrigerant charge.
  - c. Sleeves and sleeve seals.
  - d. Meters and gauges.
  - e. General-duty and specialty valves.
  - f. Hangers and supports.
4. Heating and cooling terminal and unitary equipment, including the following:
  - a. Unit heaters.
  - b. Unitary heating and cooling equipment.
5. Controls and instrumentation, including the following:
  - a. Energy monitoring and recording system.
  - b. Controllers and sensors.
  - c. Automatic control valves, dampers, and actuators.
  - d. Control interface with fans, pumps, dampers, and other equipment and systems.
  - e. Demand-control systems.
6. TAB Verification:
  - a. Airflow.
  - b. Water flow.
  - c. Space pressurization.
7. Documentation:
  - a. Mechanical systems manuals.
  - b. Documentation of required commissioning.
8. Mechanical insulation, including the following:
  - a. Duct and plenum insulation.
  - b. HVAC piping insulation.

### 3.3 Cx TESTING PREPARATION

- A. Certify that HVAC systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating in accordance with the Contract Documents and approved submittals.
- B. Certify that HVAC instrumentation and control systems have been completed and calibrated, point-to-point checkout has been successfully completed, and systems are operating in accordance with their design sequence of operation, Contract Documents, and approved

submittals. Certify that all sensors are operating within specified accuracy and all systems are set to and maintaining set points as required by the design documents.

- C. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested in accordance with approved test procedures (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

### 3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
  - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
  - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
  - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation, and schedule seasonal tests.

### 3.5 Cx TESTS COMMON TO HVAC SYSTEMS

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components for operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response in accordance with acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance test requirements specified in Division 23 Sections specifying HVAC systems and equipment.

- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
  - 1. Cx Construction Checklist verification tests.
  - 2. Cx Construction Checklist verification test demonstrations.

### 3.6 TAB VERIFICATION

- A. Prerequisites: Completion of "Examination" Article requirements and correction of deficiencies, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- B. Completion of "Preparation" Article requirements for preparation of a TAB plan that includes strategies and step-by-step procedures, and system-readiness checks and reports, as specified in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
- C. Scope: HVAC air systems and hydronic piping systems.
- D. Purpose: Differential flow relationships intended to maintain air and water pressurization differentials between the various areas of Project.
- E. Conditions of the Test:
  - 1. Cx Test Demonstration Sampling Rate: As specified in "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
  - 2. Systems operating in full heating mode.
  - 3. Systems operating in full cooling mode.
  - 4. For measurements at air-handling units with economizer controls; systems operating in economizer mode with 100 percent outside air.
- F. Acceptance Criteria:
  - 1. Under all conditions, rechecked measurements comply with "Inspections" Article in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
  - 2. Additionally, no rechecked measurement shall differ from measurements documented in the final report by more than the tolerances allowed.
  - 3. Under all conditions, where the Contract Documents indicate a differential in airflow between supply and exhaust and/or return in a space, the differential relationship shall be maintained.

END OF SECTION 230800





## SECTION 233113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Double-wall round ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

##### B. Related Requirements:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233119 "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.2 ACTION SUBMITTALS

##### A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

##### B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.

11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated Design Submittals:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports are to withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with airstream comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."
- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

## 2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
- B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
  - 2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." All longitudinal seams are to be Pittsburgh lock seams unless otherwise specified for specific application.
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
  - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elgen Manufacturing.
    - b. GreenSeam.
    - c. Linx Industries; a DMI company (formerly Lindab).
    - d. MKT Metal Manufacturing.
    - e. McGill AirFlow LLC.

- f. Nordfab Ducting.
  - g. SEMCO, LLC; part of FlaktGroup.
  - h. SHAPE Manufacturing Inc.
  - i. Set Duct Manufacturing.
  - j. Sheet Metal Connectors, Inc.
  - k. Spiral Manufacturing Co., Inc.
  - l. Stamped Fittings Inc.
  - m. Ductmate Industries, Inc; a DMI company.
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
  - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Linx Industries; a DMI company (formerly Lindab).
  - 2. MKT Metal Manufacturing.
  - 3. McGill AirFlow LLC.
  - 4. SEMCO, LLC; part of FlaktGroup.
  - 5. SHAPE Manufacturing Inc.
  - 6. Set Duct Manufacturing.
  - 7. Sheet Metal Connectors, Inc.

- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
1. Construct ducts of galvanized sheet steel unless otherwise indicated.
  2. For ducts exposed to weather, construct outer duct of Type 304 or Type 316 stainless steel indicated by manufacturer to be suitable for outdoor installation.
  3. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
  4. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
  5. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Inner Duct: Minimum 24-gauge perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.
- D. Interstitial Insulation, Flexible Elastomeric: Duct liner complying with ASTM C534/C534M, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

## 2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials are to be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  - 1. Galvanized Coating Designation: G60.
  - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish is to be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.
- D. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- E. Tie Rods: Galvanized steel, 1/4-inch-minimum diameter for lengths 36 inches or less; 3/8-inch-minimum diameter for lengths longer than 36 inches.

## 2.6 DUCT LINER

- A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C534/C534M, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.
    - d. Sekisui Voltek, LLC.
  - 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
  - 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- B. Insulation Pins and Washers:
  - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place, but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  - a. Fan discharges.
  - b. Intervals of lined duct preceding unlined duct.
  - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
  - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.7 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets are to be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 4 inches.
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.



5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal is to provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and is to be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.8 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless Steel Ducts: Stainless steel shapes and plates.
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

### PART 3 - EXECUTION

#### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.
- B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install ducts in maximum practical lengths with fewest possible joints.
- D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal

flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- J. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.
- K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- L. Elbows: Use long-radius elbows wherever they fit.
  - 1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
  - 2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.
- M. Branch Connections: Use lateral or conical branch connections.

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified on Drawings in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints. Coordinate with Section 230548 "Vibration and Seismic Controls for HVAC."
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5 DUCTWORK CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### 3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems according to the DUCT CONSTRUCTION AND LEAKAGE SCHEDULE on Sheet M-001.
  - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
  - b. Supply Ducts with a Pressure Class of 2- Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
  - c. Return Ducts with a Pressure Class of 2- Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
  - d. Exhaust Ducts with a Pressure Class of 2- Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness in accordance with "Description of Method 3 - NADCA Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
  - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media is to not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

### 3.8 STARTUP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

### 3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
  - 1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.
  - 2. Fabricate supply ductwork exposed to view in occupied spaces with double-wall galvanized duct with perforated inner liner and 2" interstitial insulation.
- B. Intermediate Reinforcement:
  - 1. Galvanized-Steel Ducts: Galvanized steel.
- C. Liner:
  - 1. Transfer Ducts: Flexible elastomeric, 1 inch thick.
- D. Elbow Configuration:
  - 1. Rectangular Duct - Requirements for All Velocities: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
  - 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
    - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
      - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
      - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
      - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
      - 4) Radius-to Diameter Ratio: 1.5.
    - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

END OF SECTION 233113



## SECTION 233300 - AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Turning vanes.
5. Duct-mounted access doors.
6. Duct access panel assemblies.
7. Flexible connectors.
8. Duct accessory hardware.

- B. Related Requirements:

1. Section 233346 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
3. Section 284621.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.
4. Section 284621.13 "Conventional Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

#### 1.3 ACTION SUBMITTALS

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
  - a. Special fittings.
  - b. Manual volume damper installations.
  - c. Control-damper installations.
  - d. Include diagrams for power, signal, and control wiring.



#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.
- B. Source quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 90A and NFPA 90B.
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

#### 2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Description: Gravity balanced.
- B. Performance:
  - 1. Maximum Air Velocity: 600 fpm.
  - 2. Maximum System Pressure: 1 inch wg.
  - 3. AMCA Certification: Test and rate in accordance with AMCA 511.
  - 4. Leakage:
    - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
    - b. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

C. Construction:

1. Frame:

- a. Hat shaped.
- b. 16-gauge-thick, galvanized sheet steel, with welded or mechanically attached corners.

2. Blades:

- a. Multiple single-piece blades.
- b. Center pivoted, maximum 6-inch width, 16-gauge-thick, galvanized sheet steel with sealed edges.

3. Blade Action: Parallel.

D. Blade Seals: Vinyl foam.

E. Blade Axles:

- 1. Material: Nonferrous metal.
- 2. Diameter: 0.20 inch.

F. Tie Bars and Brackets: Aluminum.

G. Return Spring: Adjustable tension.

H. Bearings: Steel ball, Brass sleeve or synthetic pivot bushings.

I. Damper Actuator - Electric:

- 1. Electric - 24 V ac.
- 2. UL 873 plenum rated.
- 3. Fully modulating.
  - a. Sufficient motor torque and spring torque to drive damper fully closed with adequate force to achieve required damper seal.
  - b. Minimum 90-degree drive rotation.
- 4. Clockwise or counterclockwise drive rotation as required for application.
- 5. Environmental Operating Range:
  - a. Temperature: Minus 40 to plus 130 deg F.
  - b. Humidity: 5 to 95 percent relative humidity noncondensing.
- 6. Environmental Enclosure: NEMA 2.
- 7. Actuator to be factory mounted and provided with a single-point wiring connection.

J. Controllers, Electrical Devices, and Wiring:

1. Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
2. Electrical Connection: 24 V, 60 Hz.

K. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Chain pulls.
4. Screen Mounting:
  - a. Front mounted in sleeve.
    - 1) Sleeve Thickness: 20 gauge minimum.
    - 2) Sleeve Length: 6 inches minimum.
5. Screen Material: Galvanized steel.
6. Screen Type: Insect.
7. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Air Balance; MESTEK, Inc.
  - b. Aire Technologies, Inc.; DMI Companies.
  - c. American Warming and Ventilating (AWV); Mestek, Inc.
  - d. Arrow United Industries; Mestek, Inc.
  - e. Cesco Products; MESTEK, Inc.
  - f. Greenheck Fan Corporation.
  - g. Lloyd Industries, Inc.
  - h. McGill AirFlow LLC.
  - i. Nailor Industries Inc.
  - j. Pottorff.
  - k. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  - l. Safe Air - Dowco.
  - m. United Enertech Corp.
  - n. Vent Products Co., Inc.
2. Performance:
  - a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Construction:

- a. Linkage out of airstream.
  - b. Suitable for horizontal or vertical airflow applications.
- 4. Frames:
  - a. Hat-shaped, 16-gauge-thick, galvanized sheet steel.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
- 5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized steel; 16 gauge thick.
- 6. Blade Axles: Galvanized steel.
- 7. Bearings:
  - a. Oil-impregnated bronze.
  - b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.
- 8. Tie Bars and Brackets: Galvanized steel.
- 9. Locking device to hold damper blades in a fixed position without vibration.

## 2.4 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Warming and Ventilating (AWV); Mestek, Inc.
  - 2. Arrow United Industries; Mestek, Inc.
  - 3. Carnes Company.
  - 4. Cesco Products; MESTEK, Inc.
  - 5. Greenheck Fan Corporation.
  - 6. Lloyd Industries, Inc.
  - 7. McGill AirFlow LLC.
  - 8. Metal Form Manufacturing LLC; United Enertech Corp.
  - 9. NCA Manufacturing, Inc.; Metal Industries, Inc.
  - 10. Nailor Industries Inc.
  - 11. Pottorff.
  - 12. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  - 13. Safe Air - Dowco.
  - 14. United Enertech Corp.
  - 15. Vent Products Co., Inc.
  - 16. Young Regulator Company.

B. General Requirements:

1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:
  - a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 3000 fpm.
5. Temperature: Minus 25 to plus 180 deg F.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Linkage out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:
  - a. Hat, U, or angle shaped.
  - b. 0.08-inch-thick extruded aluminum.
  - c. Mitered and welded corners.
  - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
  - a. Multiple blade with maximum blade width of 6 inches.
  - b. Parallel or Opposed-blade design.
  - c. Aluminum.
  - d. 16-gauge-thick single skin or 14-gauge-thick air foil dual skin.
5. Blade Edging Seals:
  - a. Replaceable Closed-cell neoprene.
  - b. Inflatable seal blade edging, or replaceable rubber seals.
6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; stainless steel.

8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
9. Bearings:
  - a. Molded synthetic or Stainless steel sleeve.
  - b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

E. Damper Actuator - Electric:

1. Electric - 24 V ac.
2. UL 873, plenum rated.
3. Two position.
  - a. Sufficient motor torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
  - b. Minimum 90-degree drive rotation.
4. Clockwise or counterclockwise drive rotation as required for application.
5. Environmental Operating Range:
  - a. Temperature: Minus 40 to plus 130 deg F.
  - b. Humidity: 5 to 95 percent relative humidity noncondensing.
6. Environmental enclosure: NEMA 2.
7. Actuator to be factory mounted and provided with a single-point wiring connection.

F. Controllers, Electrical Devices, and Wiring:

1. Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
2. Electrical Connection: 24 V, 60 Hz.

## 2.5 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CL WARD & Family Inc.
  2. Ductmate Industries, Inc; a DMI company.
  3. DynAir; a Carlisle Company.
  4. Elgen Manufacturing.
  5. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Description: Add-on or roll-formed, factory fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.

- D. Gauge and Shape: Match connecting ductwork.

## 2.6 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aero-Dyne Sound Control Co.
  2. CL WARD & Family Inc.
  3. Ductmate Industries, Inc; a DMI company.
  4. Duro Dyne Inc.
  5. DynAir; a Carlisle Company.
  6. Elgen Manufacturing.
  7. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- D. Vane Construction:
1. Double wall.

## 2.7 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aire Technologies, Inc.; DMI Companies.
  2. Arrow United Industries; Mestek, Inc.
  3. CL WARD & Family Inc.
  4. Cesco Products; MESTEK, Inc.
  5. Ductmate Industries, Inc; a DMI company.
  6. Duro Dyne Inc.
  7. Elgen Manufacturing.
  8. Flexmaster U.S.A., Inc.
  9. McGill AirFlow LLC.
  10. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
  11. United Enertech Corp.
  12. Ventfabrics, Inc.

13. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."
  1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. 24-gauge-thick galvanized steel door panel.
    - d. Vision panel.
    - e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - f. Fabricate doors airtight and suitable for duct pressure class.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
    - a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum frame.
  3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
    - d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
  1. Door and Frame Material: Galvanized sheet steel.
    - a. 24-gauge-thick galvanized steel door panel.
  2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
  3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
  4. Factory set at 3.0 to 8.0 inches wg.
  5. Doors close when pressures are within set-point range.
  6. Hinge: Continuous piano.
  7. Latches: Cam.
  8. Seal: Neoprene or foam rubber.
  9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.



## 2.8 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CL WARD & Family Inc.
  - 2. Ductmate Industries, Inc; a DMI company.
  - 3. Flame Gard, Inc.
- B. Access panels used in cooking applications:
  - 1. Labeled compliant to NFPA 96 for grease duct access doors.
  - 2. Labeled in accordance with UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 16-gauge galvanized steel.
- D. Fasteners: Galvanized steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96, grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10 inches wg positive or negative.

## 2.9 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CL WARD & Family Inc.
  - 2. Ductmate Industries, Inc; a DMI company.
  - 3. Duro Dyne Inc.
  - 4. DynAir; a Carlisle Company.
  - 5. Elgen Manufacturing.
  - 6. Ventfabrics, Inc.
  - 7. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Materials: Flame-retardant or noncombustible fabrics.
- E. Coatings and Adhesives: Comply with UL 181, Class 1.

- F. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- G. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
  - 3. Service Temperature: Minus 40 to plus 200 deg F.
- H. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
  - 1. Minimum Weight: 24 oz./sq. yd..
  - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  - 3. Service Temperature: Minus 50 to plus 250 deg F.
- I. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
  - 1. Minimum Weight: 16 oz./sq. yd..
  - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
  - 3. Service Temperature: Minus 67 to plus 500 deg F.
- J. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
  - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular 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. 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. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
  - 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.10 DUCT ACCESSORY HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CL WARD & Family Inc.
  - 2. Ductmate Industries, Inc; a DMI company.
  - 3. Duro Dyne Inc.
  - 4. DynAir; a Carlisle Company.

5. Elgen Manufacturing.
  6. Hardcast; Carlisle Construction Materials.
  7. United Enertech Corp.
  8. Ventfabrics, Inc.
  9. Ward Industries; a brand of Hart & Cooley, LLC.
- B. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- C. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## 2.11 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
1. Galvanized Coating Designation: G60.
  2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- C. Aluminum Sheets: Comply with ASTM B209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, one-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. At outdoor-air intakes and mixed-air plenums.
  - 3. At drain pans and seals.
  - 4. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 5. Control devices requiring inspection.
  - 6. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

- N. Install duct test holes where required for testing and balancing purposes.
- O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### 3.2 FIELD QUALITY CONTROL

#### A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

## SECTION 233346 - FLEXIBLE DUCTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Flexible ducts, noninsulated.
2. Flexible ducts, insulated.
3. Flexible duct connectors.

#### 1.2 ACTION SUBMITTALS

A. Product Data:

1. Flexible ducts, insulated.
2. Flexible duct connectors.

B. Product Data Submittals: For each type of product.

C. Shop Drawings: For flexible ducts.

1. Include plans showing locations, mounting details, and attachment details.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

### PART 2 - PRODUCTS

#### 2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A and NFPA 90B.

- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials must be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

- C. Comply with the Air Duct Council's (formerly, Air Diffusion Council) "ADC Flexible Air Duct Test Code - FD 72-R1" and "Flexible Duct Performance & Installation Standards."
- D. Comply with ASTM E96/E96M.

## 2.2 FLEXIBLE DUCTS, INSULATED

- A. Standard: Product is to be UL 181 listed and bearing the UL label.
- B. Flexible Ducts, Insulated - Class 1, Two-Ply Vinyl Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. ATCO Rubber Products, Inc.
    - b. Flexmaster U.S.A., Inc.
    - c. JP Lamborn Co.
    - d. Thermaflex; a Flex-Tek Group company.
  - 2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  - 3. Maximum Air Velocity: 4000 fpm.
  - 4. Temperature Range: Minus 10 to plus 160 deg F.
  - 5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  - 6. Vapor-Barrier Film: Polyethylene.
- C. Flexible Ducts, Insulated - Class 1, Black Polymer Film Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. CASCO C.A. Schroeder, Inc.
    - b. Flexmaster U.S.A., Inc.
    - c. JP Lamborn Co.
    - d. Thermaflex; a Flex-Tek Group company.
  - 2. Pressure Rating: 4 inch wg positive and 0.5 inch wg negative.
  - 3. Maximum Air Velocity: 4000 fpm.
  - 4. Temperature Range: Minus 20 to plus 175 deg F.
  - 5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  - 6. Vapor-Barrier Film: Polyethylene.
- D. Flexible Ducts, Insulated - Class 1, Multiple Layers of Aluminum Laminate Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Flexmaster U.S.A., Inc.
    - b. JP Lamborn Co.
    - c. Thermaflex; a Flex-Tek Group company.
  2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 20 to plus 210 deg F.
  5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  6. Vapor-Barrier Film: Polyethylene.
- E. Flexible Ducts, Insulated - Class 1, Aluminum Laminate and Polyester Film with Latex Adhesive Supported by Helically Wound, Spring-Steel Wire; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Flexmaster U.S.A., Inc.
  2. Pressure Rating: 10 inch wg positive and 1.0 inch wg negative.
  3. Maximum Air Velocity: 4000 fpm.
  4. Temperature Range: Minus 20 to plus 210 deg F.
  5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  6. Vapor-Barrier Film: Polyethylene.
- F. Flexible Ducts, Insulated - Class 0, Interlocking Spiral of Aluminum Foil; Fibrous-Glass Insulation:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Flexmaster U.S.A., Inc.
  2. Pressure Rating: 8 inch wg positive or negative.
  3. Maximum Air Velocity: 5000 fpm.
  4. Temperature Range: Minus 20 to plus 250 deg F.
  5. Insulation R-Value: Comply with ASHRAE/IES 90.1.
  6. Vapor-Barrier Film: Polyethylene.

## 2.3 FLEXIBLE DUCT CONNECTORS

- A. Clamps: Stainless steel band with stainless steel or zinc-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.



- B. Non-Clamp Connectors: Liquid adhesive plus tape.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF FLEXIBLE DUCTS

- A. Install flexible ducts in accordance with applicable details in the following publications:
1. ADC's "Flexible Duct Performance & Installation Standards" for flexible ducts.
  2. NAIMA AH116.
  3. SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
  4. SMACNA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install in indoor applications only. Do not install flexible duct in locations where it will be exposed to UV lighting.
- C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- D. Connect diffusers and light troffer boots to ducts directly or with maximum lengths of flexible duct clamped or strapped in place.
- E. Connect flexible ducts to metal ducts with draw bands.
- F. Installation:
1. Install ducts fully extended.
  2. Do not bend ducts across sharp corners.
  3. Bends of flexible ducting must not exceed a minimum of one-duct diameter.
  4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
  5. Install flexible ducts in a direct line, without sags, twists, or turns.
  6. Install in accordance with ADC instructions.
- G. Supporting Flexible Ducts:
1. Support flexible duct at manufacturer's recommended intervals, but at no greater distance than 4 ft.. Provide sufficient support so that maximum centerline sag is 1/2 in. per ft. between supports. A connection to rigid duct or equipment may be considered a support joint.
  2. Install extra supports at bends placed approximately one-duct diameter from center line of the bend.
  3. Ducts may rest on ceiling joists or truss supports. Spacing between supports must not exceed the maximum spacing in accordance with manufacturer's written installation instructions.
  4. Vertically installed ducts must be stabilized by support straps at a maximum of 72 inches o.c.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

END OF SECTION 233346



## SECTION 233713.13 - AIR DIFFUSERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Rectangular and square ceiling diffusers.

- B. Related Requirements:

- 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
  - 2. Section 233713.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.

- B. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

- 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. A-J Manufacturing Co., Inc.
  2. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
  3. Carnes Company.
  4. Hart & Cooley, LLC.
  5. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
  6. METALAIRE, Inc.
  7. Nailor Industries Inc.
  8. Price Industries Limited.
  9. Shoemaker Mfg. Co.
  10. Titus; brand of Johnson Controls International plc, Global Products.
  11. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
- B. Devices shall be specifically designed for variable-air-volume flows.
- C. Material: As indicated on drawings .
- D. Finish: As indicated on drawings .
- E. Face Size: As indicated on drawings .
- F. Face Style: As indicated on drawings .
- G. Mounting: As indicated on drawings .
- H. Pattern: As indicated on drawings .
- I. Dampers: As indicated on drawings .
- J. Accessories: As indicated on drawings

### 2.2 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install diffusers level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.13



## SECTION 233713.23 - REGISTERS AND GRILLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Adjustable blade face registers and grilles.
  - 2. Fixed face registers and grilles.

- B. Related Requirements:

- 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
  - 2. Section 233713.13 "Air Diffusers" for various types of air diffusers.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

- 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.

- B. Source quality-control reports.



## PART 2 - PRODUCTS

### 2.1 REGISTERS

#### A. Adjustable Blade Face Register:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. A-J Manufacturing Co., Inc.
  - b. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
  - c. Carnes Company.
  - d. Dayus Register & Grille Inc.
  - e. Hart & Cooley, LLC.
  - f. Kees, Inc.
  - g. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
  - h. METALAIRE, Inc.
  - i. Nailor Industries Inc.
  - j. Price Industries Limited.
  - k. Titus; brand of Johnson Controls International plc, Global Products.
  - l. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
2. Material: As indicated on drawings.
3. Finish: As indicated on drawings .
4. Face Blade Arrangement: As indicated on drawings.
5. Core Construction: As indicated on drawings.
6. Rear-Blade Arrangement: As indicated on drawings.
7. Frame: As indicated on drawings.
8. Mounting Frame: As indicated on drawings.
9. Mounting: As indicated on drawings.
10. Damper Type: As indicated on drawings.
11. Accessories: As indicated on drawings.

#### B. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. A-J Manufacturing Co., Inc.
  - b. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
  - c. Carnes Company.
  - d. Dayus Register & Grille Inc.
  - e. Hart & Cooley, LLC.
  - f. Kees, Inc.
  - g. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
  - h. Nailor Industries Inc.

- i. Price Industries Limited.
  - j. Shoemaker Mfg. Co.
  - k. Titus; brand of Johnson Controls International plc, Global Products.
  - l. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
2. Material: As indicated on drawings.
3. Finish: As indicated on drawings.
4. Face Blade Arrangement: As indicated on drawings.
5. Face Arrangement: Perforated core.
6. Core Construction: As indicated on drawings.
7. Frame: As indicated on drawings.
8. Mounting Frame: As indicated on drawings.
9. Mounting: As indicated on drawings.
10. Damper Type: As indicated on drawings.
11. Accessory: As indicated on drawings.

## 2.2 GRILLES

### A. Adjustable Blade Face Grille:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. A-J Manufacturing Co., Inc.
  - b. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
  - c. Carnes Company.
  - d. Dayus Register & Grille Inc.
  - e. Hart & Cooley, LLC.
  - f. Kees, Inc.
  - g. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
  - h. METALAIRE, Inc.
  - i. Nailor Industries Inc.
  - j. Price Industries Limited.
  - k. Raymon Company.
  - l. Shoemaker Mfg. Co.
  - m. Titus; brand of Johnson Controls International plc, Global Products.
  - n. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
2. Material: As indicated on drawings.
3. Finish: As indicated on drawings.
4. Face Blade Arrangement: As indicated on drawings.
5. Core Construction: As indicated on drawings.
6. Rear-Blade Arrangement: As indicated on drawings.
7. Frame: As indicated on drawings.
8. Mounting Frame: As indicated on drawings.
9. Mounting: As indicated on drawings.
10. Accessories: As indicated on drawings.

B. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. A-J Manufacturing Co., Inc.
  - b. Anemostat Air Distribution; Anemostat, Inc.; Mestek, Inc.
  - c. Carnes Company.
  - d. Dayus Register & Grille Inc.
  - e. Hart & Cooley, LLC.
  - f. Kees, Inc.
  - g. Krueger-HVAC; brand of Johnson Controls International plc, Global Products.
  - h. Nailor Industries Inc.
  - i. Price Industries Limited.
  - j. Shoemaker Mfg. Co.
  - k. Titus; brand of Johnson Controls International plc, Global Products.
  - l. Tuttle & Bailey; brand of Johnson Controls International plc, Global Products.
2. Material: As indicated on drawings.
3. Finish: As indicated on drawings.
4. Face Blade Arrangement: As indicated on drawings.
5. Face Arrangement: Perforated core.
6. Core Construction: As indicated on drawings.
7. Frame: As indicated on drawings.
8. Mounting Frame: As indicated on drawings.
9. Mounting: As indicated on drawings.
10. Accessory: Filter.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install registers and grilles level and plumb.
- B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.3 ADJUSTING

- A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713.23



## SECTION 233723 - HVAC GRAVITY VENTILATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Hooded ventilators.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product

- B. Shop Drawings: For gravity ventilators.

- 1. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.
  - 2. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Roof-framing plans and other details, drawn to scale, and coordinated with each other, based on input from installers of the items involved:

#### 1.5 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
  - 1. Wind Loads, Indicated on Drawings: Determine loads based on pressures as indicated on Drawings.
- B. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
- C. ASHRAE 62.1 Compliance: Section 5, "Systems and Equipment" and Section 7, "Construction and System Start-up."
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
  - 1. Temperature Change (Range):
    - a. Ambient: 120 deg F.
    - b. Material Surfaces: 180 deg F.
- E. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.
- F. Capacities and Characteristics: As indicated on drawings.

### 2.2 FABRICATION

- A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.
- B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
- C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.
- D. Fabricate supports, anchorages, and accessories required for complete assembly.
- E. Perform shop welding by AWS-certified procedures and personnel.

## 2.3 HOODED VENTILATORS

- A. Description: Hooded round penthouse for intake air.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acme Engineering & Manufacturing Corp.
  - 2. Carnes Company.
  - 3. Greenheck Fan Corporation.
  - 4. JencoFan.
  - 5. Loren Cook Company.
  - 6. PennBarry; division of Air System Components.
  - 7. Safe Air - Dowco.
  - 8. Twin City Fan & Blower.
- C. Source Limitations: Obtain hooded ventilators from single manufacturer.
- D. Construction:
  - 1. Material, Aluminum: Thickness required to comply with structural performance requirements, but not less than 0.063-inch-thick base and 0.050-inch-thick hood; suitably reinforced.
  - 2. Insulation: None.
  - 3. Insect Screening: Aluminum, 18-by-16 mesh wire.
- E. Galvanized-Steel 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 A780/A780M. Apply a conversion coating suited to the organic coating to be applied over it.
  - 2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.
  - 3. 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.
    - a. Color and Gloss: As indicated by manufacturer's designations.
- F. Dampers:
  - 1. Location: Hood neck.
  - 2. Control: Gravity backdraft.
  - 3. Tray: Provide damper tray or shelf with opening 3 inches less than interior curb dimensions indicated.



- G. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch-thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
  - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
  - 2. Overall Height: 12 inches.

## 2.4 SOURCE QUALITY CONTROL

- A. AMCA Certification for Hooded Ventilators: Test, rate, and label gravity ventilators in accordance with AMCA 511.

## 2.5 MATERIALS

- A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5 or T-52.
- B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming or as otherwise recommended by metal producer for required finish.
- C. Galvanized-Steel Sheet: ASTM A653/A653M, G90 zinc coating, mill phosphatized.
- D. Stainless Steel Sheet: ASTM A666, Type 304, with No. 4 finish.
- E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
  - 1. Use types and sizes to suit unit installation conditions.
  - 2. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
- F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.
- B. Secure gravity ventilators to roof curbs with zinc-plated hardware, that comply with the wind fastening requirements. Use concealed anchorages where possible. Refer to Section 077200 "Roof Accessories."

- C. Install gravity ventilators with clearances for service and maintenance.
- D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.
- F. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes, so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- I. Refer to Section 077200 "Roof Accessories" for flashing and counterflashing of roof curbs.

### 3.2 DUCT CONNECTIONS

- A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

### 3.3 ADJUSTING

- A. Adjust damper linkages for proper damper operation.

END OF SECTION 233723



## SECTION 238129 - VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes: VRF HVAC systems.

1. Indoor, multi-position air units for ducting.
2. Indoor, exposed, wall-mounted units.
3. Indoor, recessed, ceiling-mounted units.
4. Indoor, dedicated outdoor air ventilation units.
5. Outdoor, air-source heat-pump units.
6. Outdoor, air-source heat recovery units.
7. Heat recovery control units (HRCUs).
8. System controls.
9. System refrigerant and oil.
10. System condensate drain piping.
11. System hydronic piping.
12. System refrigerant piping.
13. Metal hangers and supports.
14. Metal framing systems.
15. Fastener systems.
16. Pipe stands.
17. Outdoor equipment stands.
18. Miscellaneous support materials.
19. Piping and tubing insulation.
20. System control cable.

#### 1.2 DEFINITIONS

- A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.
- B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.
- C. Heat Recovery System Operation: System capable of operation with simultaneous heating and cooling zones that transfer heat between zones.
- D. HRCU: Heat Recovery Control Unit. HRCUs are used in heat recovery VRF HVAC systems to manage and control refrigerant between indoor units to provide simultaneous heating and cooling zones. "Heat Recovery Control Unit" is the term used by ASHRAE for what different manufacturers term as branch circuit controller, branch selector box, changeover box, flow selector unit, mode change unit, and other such terms.

- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- F. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- G. Three-Pipe System Design: One high pressure refrigerant vapor line, one low pressure refrigerant vapor line, and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One liquid line and refrigerant vapor line connect HRCUs to associated indoor units.
- H. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.
- I. VRF: Variable refrigerant flow.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For VRF HVAC system components.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units and for HRCUs.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
  - 4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
  - 5. Include system operating sequence of operation in narrative form for each unique indoor-and outdoor-unit and HRCU control.
  - 6. Include description of control software features.
  - 7. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
  - 8. Include refrigerant type and data sheets showing compliance with requirements indicated.
  - 9. For system design software.
  - 10. Indicate location and type of service access.
- B. Shop Drawings: For VRF HVAC systems.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams and details of refrigerant piping and tubing showing installation requirements for manufacturer-furnished divided flow fittings.
5. Include diagrams for power, signal, and control wiring.

C. Delegated Design Submittals:

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.
2. Include design calculations with corresponding diagram of refrigerant piping and tubing sizing for each system installed.
3. Include design calculations with corresponding floor plans indicating that refrigerant concentration limits are within allowable limits of ASHRAE 15 and governing codes.
4. Include calculations showing that system travel distance for refrigerant piping and controls cabling are within horizontal and vertical travel distances set by manufacturer. Provide a comparison table for each system installed.

#### 1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, sections, and details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural floors, roofs and associated members to which equipment, piping, ductwork, cables, and conduit will be attached.
3. Size and location of initial access modules for acoustical tile.
4. Wall-mounted controllers located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
5. Size and location of access doors and panels installed behind walls and inaccessible ceilings for products installed behind walls and requiring access.
6. Items penetrating finished ceiling including the following:
  - a. Luminaires.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Service access panels.

B. Qualification Data:

1. For Installer: Certificate from VRF HVAC system manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.

- a. Retain copies of Installer certificates on-site and make available on request.
- 2. For VRF HVAC system manufacturer.
- 3. For VRF HVAC system provider.
- C. Product Test Reports: Where tests are required, for each product, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranties: For manufacturer's warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On CD or DVD, USB media, or approved cloud storage platform, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Filters:
    - a. One set for each unit with replaceable filters.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. Nationally recognized manufacturer of VRF HVAC systems and products.
  - 2. Shipped VRF HVAC systems with similar requirements to those indicated for a continuous period of five years within time of bid.
  - 3. VRF HVAC systems and products that have been successfully tested and in use on at least three completed projects.
  - 4. Having complete published catalog literature, installation, and operation and maintenance manuals for all products intended for use.

5. Having full-time in-house employees for the following:

- a. Product research and development.
- b. Product and application engineering.
- c. Product manufacturing, testing, and quality control.
- d. Technical support for system installation training, startup, commissioning, and troubleshooting of installations.
- e. Owner training.

B. Factory-Authorized Service Representative Qualifications:

1. Authorized representative of, and trained by, VRF HVAC system manufacturer.
2. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
3. Demonstrated past experience on five projects of similar complexity, scope, and value.
  - a. Each person assigned to Project shall have demonstrated past experience.
4. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
5. Service and maintenance staff assigned to support Project during warranty period.
6. Product parts inventory to support ongoing system operation for a period of not less than five years after Final Acceptance.
7. VRF HVAC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.

1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
2. Installer certification shall be valid and current for duration of Project.
3. Retain copies of Installer certificates on-site and make available on request.
4. Each person assigned to Project shall have demonstrated past experience.
  - a. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
  - b. Demonstrated past experience on five projects of similar complexity, scope, and value.

D. ISO Compliance: System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.



- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
  - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
  - 2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

## 1.9 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period:
    - a. For Compressor: Five year(s) from date of Final Acceptance.
    - b. For Parts, Including Controls: Five year(s) from date of Final Acceptance.
    - c. For Labor: Five year(s) from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 VRF HVAC SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Daikin Applied.
  - 2. LG Electronics USA, Inc.; LG Electronics Inc.
  - 3. Mitsubishi Electric & Electronics USA, Inc.
  - 4. Samsung HVAC.
  - 5. Trane Inc.

- B. Source Limitations: Obtain products from single source from single manufacturer including, but not limited to, the following:
1. Indoor and outdoor units, including accessories.
  2. Controls and software.
  3. HRCUs.
  4. Refrigerant isolation valves.
  5. Specialty refrigerant pipe fittings.

## 2.2 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
1. Two-pipe or three-pipe system design.
  2. System(s) operation, heat pump or heat recovery as indicated on Drawings.
  3. Each system with one refrigerant circuit shared by all indoor units connected to system.
- 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. AHRI Compliance: System and equipment performance certified according to AHRI 1230.
- D. ASHRAE Compliance:
1. ASHRAE 15: For safety code for mechanical refrigeration.
  2. ASHRAE 62.1: For indoor air quality.
  3. ASHRAE 135: For control network protocol with remote communication.
  4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.
- E. UL Compliance: Comply with UL 1995.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Engage a qualified professional **specialist**, as defined in Section 014000 "Quality Requirements," to design complete and operational VRF HVAC system(s) complying with requirements indicated.
1. System Refrigerant Piping and Tubing:
    - a. Arrangement: Arrange piping to interconnect indoor units, HRCUs, and outdoor unit(s) in compliance with manufacturer requirements and requirements indicated.
    - b. Routing: Conceal piping above ceilings and behind walls to maximum extent possible.

- c. Sizing: Size piping system, using a software program acceptable to manufacturer, to provide performance requirements indicated. Consider requirements to accommodate future change requirements.
  2. System Controls:
    - a. Network arrangement.
    - b. Network interface with other building systems.
    - c. Product selection.
    - d. Sizing.
- B. Service Access:
  1. Provide and document service access requirements.
  2. Locate equipment, system isolation valves, and other system components that require service and inspection in easily accessible locations. Avoid locations that are difficult to access if possible.
  3. Where serviceable components are installed behind walls and above inaccessible ceilings, provide finished assembly with access doors or panels to gain access. Properly size the openings to allow for service, removal, and replacement.
  4. If less than full and unrestricted access is provided, locate components within an 18-inch reach of the finished assembly.
  5. Where ladder access is required to service elevated components, provide an installation that provides for sufficient access within ladder manufacturer's written instructions for use.
  6. Comply with OSHA regulations.
- C. System Design and Installation Requirements:
  1. Design and install systems indicated according to manufacturer's recommendations and written instructions.
  2. Where manufacturer's requirements differ from requirements indicated, contact Architect for direction. The most stringent requirements should apply unless otherwise directed in writing by Architect.
- D. Isolation of Equipment: Provide isolation valves to isolate each HRCU, indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
- E. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
  1. Not less than 50 percent.
  2. Not more than 130 percent.
  3. Range acceptable to manufacturer.
- F. System Turndown: Stable operation down to 20 percent of outdoor-unit capacity.
- G. System Auto Refrigerant Charge: Each system shall have an automatic refrigerant charge function to ensure the proper amount of refrigerant is installed in system.

H. Outdoor Conditions:

1. Suitable for outdoor ambient conditions encountered.
  - a. Design equipment and supports to withstand wind loads of governing code.
  - b. Provide corrosion-resistant coating for components and supports where located in coastal or industrial climates that are known to be harmful to materials and finishes.
2. Maximum System Operating Outdoor Temperature: See Drawings.
3. Minimum System Operating Outdoor Temperature: See Drawings.

I. Sound Performance: Sound levels generated by operating HVAC equipment shall be within requirements indicated.

1. Indoor: Within design guidelines of "2019 ASHRAE HANDBOOK- HVAC Applications."
2. Outdoor: See Drawings.

J. Thermal Movements: Allow for controlled thermal movements from ambient, surface, and system temperature changes.

K. Capacities and Characteristics: As indicated on Drawings.

2.4 INDOOR, MULTI-POSITION AIR HANDLING UNITS FOR DUCTING

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.

B. Cabinet:

1. Material: Galvanized or painted steel.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
4. Mounting: Manufacturer-designed provisions for field installation.
5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.

6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:

1. Fan(s):
  - a. Direct-drive arrangement.
  - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
  - c. Fabricated from non-ferrous components or ferrous components with corrosion-resistant finish.
  - d. Wheels statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
2. Efficiency: ASHRAE 52.2, MERV 8.
3. Media: If more than one filter type is indicated, Contractor has option to choose.
  - a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
  - b. Washable: Manufacturer's standard filter with antimicrobial treatment.

G. Unit Accessories:

1. Outdoor Air Ventilation Kit: Connection, motorized damper, and control sized to allow sequence of operation indicated on Drawings.
2. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.

H. Unit Controls:

1. Factory-Installed Controller: Configurable digital control.
2. Factory-Installed Sensors:
  - a. Unit inlet air temperature.
  - b. Coil entering refrigerant temperature.
  - c. Coil leaving refrigerant temperature.
3. Features and Functions:
  - a. Self-diagnostics.
  - b. Time delay.
  - c. Auto-restart.
  - d. External static pressure control.
  - e. Auto operation mode.
  - f. Manual operation mode.
  - g. Filter service notification.
  - h. Power consumption display.
  - i. Drain assembly high water level safety shutdown and notification.
  - j. Run test switch.
4. Communication: Network communication with other indoor and outdoor units.
5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

I. Unit Electrical:

1. Enclosure: Metal, suitable for indoor locations.
2. Field Connection: Single point connection to power unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in raceways.

2.5 INDOOR, EXPOSED, WALL-MOUNTED UNITS

- A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
- B. Cabinet:
1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.

2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Condensate pump with check valve.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:

1. Fan(s):
  - a. Direct-drive arrangement.
  - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
  - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
  - d. Wheels statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Front, to accommodate filter replacement without the need for tools.
2. Efficiency: MERV 8.

3. Washable Media: Manufacturer's standard filter with antimicrobial treatment.
  - G. Grille Assembly: Manufacturer's standard discharge grille with field-adjustable air pattern mounted in top or front face of unit cabinet.
  - H. Unit Accessories:
    1. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
    2. Condensate Pump: Integral reservoir and control with electrical power connection through unit power.
  - I. Unit Controls:
    1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
    2. Factory-Installed Controller: Configurable digital control.
    3. Factory-Installed Sensors: Unit inlet air temperature, Coil entering refrigerant temperature, and Coil leaving refrigerant temperature.
    4. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification, power consumption display, drain assembly high water level safety shutdown and notification, run test switch.
    5. Communication: Network communication with other indoor units and outdoor unit(s).
    6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
    7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  - J. Unit Electrical:
    1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
    2. Field Connection: Single point connection to power entire unit and integral controls.
    3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
    4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
    5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
    6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.
- 2.6 INDOOR, RECESSED, CEILING-MOUNTED 4-WAY CASSETTE UNITS
- A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
  - B. Cabinet:



1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Coil Casing: Aluminum, galvanized, or stainless steel.
2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Internal Tubing: Copper tubing with brazed joints.
6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:

1. Fan(s):
  - a. Direct-drive arrangement.
  - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
  - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
  - d. Wheels statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

F. Filter Assembly:

1. Access: Bottom, to accommodate filter replacement without the need for tools.

2. Efficiency: ASHRAE 52.2, MERV 7.
  3. Media: If more than one filter type is indicated, Contractor has option to choose.
    - a. Replaceable: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.
    - b. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.
1. Discharge Pattern: One-, two-, three-, or four-way throw as indicated on Drawings.
    - a. Discharge Pattern Adjustment: Field-adjustable limits for up and down range of motion.
    - b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns.
  2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.
  3. Additional Branch Supply Duct Connection: Sheet metal knockout for optional connection to one additional supply branch duct.
- H. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.
- I. Outdoor Air Ventilation Connection: Sheet metal knockout for optional connection to outdoor air ventilation duct.
- J. Unit Accessories:
1. Outdoor Air Ventilation Kit: Connection, motorized damper, and control to satisfy unit control sequence of operation indicated on Drawings.
  2. Remote Room Temperature Sensor Kit: Wall-mounted, hardwired room temperature sensor kit for use in rooms that do not have room temperature measurement.
- K. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
  2. Factory-Installed Controller: Configurable digital control.
  3. Factory-Installed Sensors: Unit inlet air temperature, Coil entering refrigerant temperature, and Coil leaving refrigerant temperature.
  4. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification, power consumption display, and drain assembly high water level safety shutdown and notification .
  5. Communication: Network communication with other indoor units and outdoor unit(s).
  6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- L. Unit Electrical:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

## 2.7 INDOOR, OUTDOOR AIR PROCESSING UNITS

- A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
1. Specially designed for up to 100 percent outdoor air entering unit.
- B. Cabinet:
1. Material: Galvanized or painted steel.
  2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
  3. Duct Connections: Extended collar or flange, or designated exterior cabinet surface, designed for attaching field-installed ductwork.
  4. Mounting: Manufacturer-designed provisions for field installation.
  5. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
  2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
  3. Coil Tubes: Copper, of diameter and thickness required by performance.
  4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
  5. Unit Internal Tubing: Copper tubing with brazed joints.
  6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  7. Field Piping Connections: Manufacturer's standard.
  8. Factory Charge: Dehydrated air or nitrogen.
  9. Testing: Factory pressure tested and verified to be without leaks.
- D. DX Coil Assembly for Reheat Applications: Provide units with a reheat coil where indicated on Drawings.
1. Coil Casing: Aluminum, galvanized, or stainless steel.
  2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.

3. Coil Tubes: Copper, of diameter and thickness required by performance.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
5. Unit Internal Tubing: Copper tubing with brazed joints.
6. Unit Internal Tubing Insulation: Manufacturer's standard insulation.
7. Field Piping Connections: Manufacturer's standard.
8. Factory Charge: Dehydrated air or nitrogen.
9. Testing: Factory pressure tested and verified to be without leaks.

E. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
3. Field Piping Connection: Non-ferrous material with threaded NPT.

F. Fan and Motor Assembly:

1. Fan(s):
  - a. Direct-drive arrangement.
  - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
  - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
  - d. Wheels statically and dynamically balanced.
2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
5. Vibration Control: Integral isolation to dampen vibration transmission.

G. Filter Assembly:

1. Access: Bottom, side, or rear to accommodate field installation without removing ductwork and to accommodate filter replacement without need for tools.
2. Efficiency: ASHRAE 52.2, MERV 11.
3. Replaceable Media: Extended surface, panel, or cartridge with antimicrobial treatment fiber media.

H. Unit Accessories:

1. Motorized Inlet Damper Kit: Low-leakage damper with spring return electric actuator to fail closed on loss of power. Damper controlled by unit to open when unit is operating and close when unit off.

I. Unit Controls:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.

2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors: Coil entering refrigerant temperature, Coil leaving refrigerant temperature, Unit entering-air temperature, Unit leaving-air temperature, Unit entering-air relative humidity, and Unit leaving-air relative humidity.
4. Features and Functions: Self-diagnostics, time delay, auto-restart, auto operation mode, manual operation mode, filter service notification, and drain assembly high water level safety shutdown and notification.
5. Communication: Network communication with other indoor units and outdoor unit(s).
6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

J. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

2.8 OUTDOOR, AIR-SOURCE HEAT-PUMP UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with either all heating or all cooling demands, but not for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3. All units installed shall be from the same product development generation.

B. Cabinet:

1. Galvanized steel and coated with a corrosion-resistant finish.
  - a. Coating with documented salt spray test performance of 3,000 hours according ASTM B117 surface scratch test (SST) procedure.
2. Mounting: Manufacturer-designed provisions for field installation.
3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Compressor and Motor Assembly:

1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
2. Protection: Integral protection against the following:
  - a. High refrigerant pressure.
  - b. Low oil level.
  - c. High oil temperature.
  - d. Thermal and overload.
  - e. Voltage fluctuations.
  - f. Phase failure and phase reversal.
  - g. Short cycling.
3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
4. Vibration Control: Integral isolation to dampen vibration transmission.
5. Oil management system to ensure safe and proper lubrication over entire operating range.
6. Crankcase heaters with integral control to maintain safe operating temperature.
7. Fusible plug.

D. Condenser Coil Assembly:

1. Plate Fin Coils:
  - a. Casing: Aluminum, galvanized, or stainless steel.
  - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
  - c. Tubes: Copper, of diameter and thickness required by performance.
2. Aluminum Microchannel Coils:
  - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
  - b. Single- or multiple-pass arrangement.
  - c. Construct fins, tubes, and header manifolds of aluminum alloy.
3. Coating: Coating with documented salt spray test performance of 3,000 hours according to ASTM B117 surface scratch test (SST) procedure.

E. Condenser Fan and Motor Assembly:

1. Fan(s): Propeller type.
  - a. Direct-drive arrangement.
  - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
  - c. dynamically balanced.

2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
  3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
  4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
  6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
  2. Factory-Installed Controller: Configurable digital control.
  3. Factory-Installed Sensors:
    - a. Refrigerant suction temperature.
    - b. Refrigerant discharge temperature.
    - c. Outdoor air temperature.
    - d. Refrigerant high pressure.
    - e. Refrigerant low pressure.
    - f. Oil level.
  4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, run test switch, and equalize run time between multiple same components.
  5. Communication: Network communication with indoor units and other outdoor unit(s).
  6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
  2. Field Connection: Single point connection to power entire unit and integral controls.
  3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
  4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
  5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 3,000 hours according to ASTM B117.

J. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.9 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

1. Specially designed for use in systems with simultaneous heating and cooling.
2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
3. All units installed shall be from the same product development generation.

B. Cabinet:

1. Galvanized steel and coated with a corrosion-resistant finish.
  - a. Coating with documented salt spray test performance of 3000 hours according ASTM B117 surface scratch test (SST) procedure.
2. Mounting: Manufacturer-designed provisions for field installation.
3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Compressor and Motor Assembly:

1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
2. Protection: Integral protection against the following:
  - a. High refrigerant pressure.
  - b. Low oil level.
  - c. High oil temperature.
  - d. Thermal and overload.
  - e. Voltage fluctuations.
  - f. Phase failure and phase reversal.
  - g. Short cycling.
3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
4. Vibration Control: Integral isolation to dampen vibration transmission.



5. Oil management system to ensure safe and proper lubrication over entire operating range.
6. Crankcase heaters with integral control to maintain safe operating temperature.
7. Fusible plug.

D. Condenser Coil Assembly:

1. Plate Fin Coils:
  - a. Casing: Aluminum, galvanized, or stainless steel.
  - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
  - c. Tubes: Copper, of diameter and thickness required by performance.
2. Aluminum Microchannel Coils:
  - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
  - b. Single- or multiple-pass arrangement.
  - c. Construct fins, tubes, and header manifolds of aluminum alloy.
3. Coating: Coating with documented salt spray test performance of 3,000 hours according to ASTM B117 surface scratch test (SST) procedure.

E. Condenser Fan and Motor Assembly:

1. Fan(s): Propeller type.
  - a. Direct-drive arrangement.
  - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
  - c. Dynamically balanced.
2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
6. Vibration Control: Integral isolation to dampen vibration transmission.

F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

G. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Factory-Installed Sensors:

- a. Refrigerant suction temperature.
    - b. Refrigerant discharge temperature.
    - c. Outdoor air temperature.
    - d. Refrigerant high pressure.
    - e. Refrigerant low pressure.
    - f. Oil level.
    - g. **<Insert sensor>**.
  4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode , manual operation mode , night setback control , power consumption display , run test switch equalize run time between multiple same components .
  5. Communication: Network communication with indoor units and other outdoor unit(s).
  6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
  2. Field Connection: Single point connection to power entire unit and integral controls.
  3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
  4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
  5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 3000hours according ASTM B117.
- J. Unit Piping:
1. Unit Tubing: Copper tubing with brazed joints.
  2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  3. Field Piping Connections: Manufacturer's standard.
  4. Factory Charge: Dehydrated air or nitrogen.
  5. Testing: Factory pressure tested and verified to be without leaks.

## 2.10 HEAT RECOVERY CONTROL UNITS (HRCUs)

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
1. Specially designed for use in systems with simultaneous heating and cooling.

2. Systems shall consist of one unit, or multiple unit that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.

B. Cabinet:

1. Galvanized-steel construction.
2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
3. Mounting: Manufacturer-designed provisions for field installation.
4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.

D. Refrigeration Assemblies and Specialties:

1. Specially designed by manufacturer for type of VRF HVAC system being installed, either two or three pipe.
2. Each refrigerant branch circuit shall have refrigerant control valve(s) to control refrigerant flow.
3. Spares: Each heat recovery control unit shall include at least one branch circuit port(s) for future use.
4. Each system piping connection upstream of heat recovery unit shall be fitted with an isolation valve to allow for service to any heat recovery control unit in the system without interrupting operation of the system.
5. Each branch circuit connection shall be fitted with an isolation valve and capped service port to allow for service to any individual branch circuit without interrupting operation of the system.
  - a. If not available as an integral part of the heat recovery control unit, isolation valves shall be field installed adjacent to the unit pipe connection.

E. Unit Controls:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Factory-Installed Controller: Configurable digital control.
3. Features and Functions: Self-diagnostics, fuse protection.
4. Communication: Network communication with indoor units and outdoor unit(s).
5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

F. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.

3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in raceways to comply with NFPA 70.

G. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.11 SYSTEM CONTROLS

A. General Requirements:

1. Network: Indoor units, HRCUs, and outdoor units shall include integral controls and connect through a TIA-485A or manufacturer-selected control network.
2. Network Communication Protocol: Manufacturer proprietary or open control communication between interconnected units.
3. Integration with Building Automation System: ASHRAE 135, BACnet IP and certified by BACnet Testing Lab (BTL), including the following:
  - a. Ethernet connection via RJ-45 connectors and port with transmission at 100 Mbps or higher.
  - b. Integration devices shall be connected to local uninterruptible power supply unit(s) to provide at least 5 minutes of battery backup operation after a power loss.
  - c. Integration shall include monitoring and scheduling.
4. Operator Interface:
  - a. Operators shall interface with system and unit controls through the following:
    - 1) Operator interfaces integral to controllers.
    - 2) Integration with Building Automation System.
  - b. Users shall be capable of interface with controllers for indoor units control to extent privileges are enabled. Control features available to users shall include the following:
    - 1) On/off control.
    - 2) Temperature set-point adjustment.

B. Central Controllers:

1. Centralized control for all indoor and outdoor units from a single central controller location.
  - a. Include multiple interconnected controllers as required.
2. Controls operation mode of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units. Operation modes available through central controller shall match those operation modes of controllers for indoor units.
3. Schedule operation of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
  - a. Sets schedule for daily, weekly, and annual events.
  - b. Schedule options available through central controller shall at least include the schedule options of controllers for indoor units.
4. Changes operating set points of indoor units as individual units, by selected groups of indoor units, or as collection of all indoor units.
5. Optimized start feature to start indoor units before scheduled time to reach temperature set-point at scheduled time based on operating history.
6. Night setback feature to operate indoor units at energy-conserving heating and cooling temperature set-points during unoccupied periods.
7. Service diagnostics tool.
8. Able to disable and enable operation of individual controllers for indoor units.
9. Information displayed on individual controllers shall also be available for display through central controller.
10. Information displayed for outdoor units, including refrigerant high and low pressures percent capacity.
11. Multiple RJ-45 ports for direct connection to a local PC and an Ethernet network switch.
12. Operator interface through a backlit, high-resolution color display touch panel.

C. Wired Controllers for Indoor Units:

1. Single controller capable of controlling multiple indoor units as group.
2. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
3. Multiple Language: English or Spanish.
4. Temperature Units: Fahrenheit and Celsius.
5. On/Off: Turns indoor unit on or off.
6. Hold: Hold operation settings until hold is released.
7. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
8. Temperature Display: 1-degree increments.
9. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments between 55 and 85 degrees F.
10. Relative Humidity Display: 1 percent increments.
11. Relative Humidity Set-Point: Adjustable in 1 percent increments between 40 and 60 percent.
12. Fan Speed Setting: Select between available options furnished with the unit.

13. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
14. Seven-day programmable operating schedule with up to five events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.
15. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
16. Occupancy detection.
17. Service Notification Display: "Filter".
18. Service Run Tests: Limit use by service personnel to troubleshoot operation.
19. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
20. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
21. Setting stored in nonvolatile memory to ensure that settings are not lost if power is lost. Battery backup for date and time only.
22. Low-voltage power required for controller shall be powered through non-polar connections to indoor unit.

D. Wireless Controllers for Indoor Units:

1. Wireless Communication:
  - a. Controller communicates to remote-mounted receiver that is wired to indoor unit(s).
    - 1) Include receivers with wireless controllers as required to complete installation.
    - 2) Low-voltage power required for receivers shall be powered through non-polar connections to indoor unit.
  - b. One wireless controller shall be capable of communicating with one or multiple receivers to control one or multiple indoor units as a group.
2. Controller Battery Life: Three years.
3. Auto Timeout Touch Screen LCD: Timeout duration shall be adjustable.
4. Multiple Language: English or Spanish.
5. Temperature Units: Fahrenheit and Celsius.
6. On/Off: Turns indoor unit on or off.
7. Hold: Hold operation settings until hold is released.
8. Operation Mode: Cool, Heat, Auto, Dehumidification, Fan Only, and Setback.
9. Temperature Display: 1-degree increments.
10. Temperature Set-Point: Separate set points for Cooling, Heating, and Setback. Adjustable in 1-degree increments between 55 and 85 degrees F.
11. Relative Humidity Display: 1 percent increments.
12. Relative Humidity Set-Point: Adjustable in 1 percent increments between 40 and 60 percent.
13. Fan Speed Setting: Select between available options furnished with the unit.
14. Airflow Direction Setting: If applicable to unit, select between available options furnished with the unit.
15. Seven-day programmable operating schedule with up to five events per day. Operations shall include On/Off, Operation Mode, and Temperature Set-Point.

16. Auto Off Timer: Operates unit for an adjustable time duration and then turns unit off.
17. Occupancy detection.
18. Service Notification Display: "Filter".
19. Service Run Tests: Limit use by service personnel to troubleshoot operation.
20. Error Code Notification Display: Used by service personnel to troubleshoot abnormal operation and equipment failure.
21. User and Service Passwords: Capable of preventing adjustments by unauthorized users.
22. Setting stored in non-volatile memory to ensure that settings are not lost if power is lost. Battery for date and time only.

## 2.12 SYSTEM REFRIGERANT AND OIL

### A. Refrigerant:

1. As required by VRF HVAC system manufacturer for system to comply with performance requirements indicated.
2. ASHRAE 34, Class A1 refrigerant classification.
3. R-410a.

### B. Oil:

1. As required by VRF HVAC system manufacturer and to comply with performance requirements indicated.

## 2.13 SYSTEM CONDENSATE DRAIN PIPING

### A. If more than one material is listed, material selection is Contractor's option.

### B. Copper Tubing:

1. Drawn-Temper Tubing: According to ASTM B88, Type L or Type DWV according to ASTM B306.
2. Wrought-Copper Fittings: ASME B16.22.
3. Wrought-Copper Unions: ASME B16.22.
4. Solder Filler Metals: ASTM B32, lead-free alloys, and water-flushable flux according to ASTM B813.

## 2.14 SYSTEM REFRIGERANT PIPING

### A. Comply with requirements in Section 232300 "Refrigerant Piping" for system piping requirements.

### B. Refrigerant Piping:

1. Copper Tube: ASTM B280, Type ACR.
2. Wrought-Copper Fittings: ASME B16.22.

3. Brazing Filler Metals: AWS A5.8/A5.8M.

C. Refrigerant Tubing Kits:

1. Furnished by VRF HVAC system manufacturer.
2. Factory-rolled and -bundled, soft-copper tubing with tubing termination fittings at each end.
3. Standard one-piece length for connecting to indoor units.
4. Pre-insulated with flexible elastomeric insulation of thickness to comply with governing energy code and sufficient to eliminate condensation.
5. Factory Charge: Dehydrated air or nitrogen.

D. Divided-Flow Specialty Fittings: Where required by VRF HVAC system manufacturer for proper system operation, VRF HVAC system manufacturer shall furnish specialty fittings with identification and instructions for proper installation by Installer.

E. Refrigerant Isolation Ball Valves:

1. Description: Uni-body full port design, rated for maximum system temperature and pressure, and factory tested under pressure to ensure tight shutoff. Designed for valve operation without removing seal cap.
2. Seals: Compatible with system refrigerant and oil. Seal service life of at least 20 years.
3. Valve Connections: Flare or sweat depending on size.

## 2.15 METAL HANGERS AND SUPPORTS

A. Copper Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized or copper-coated steel.

## 2.16 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with inturned lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel for use indoors and of stainless steel for use outdoors.
7. Metallic Coating for Use Indoors: No coating.



8. Plastic Coating for Use Outdoors: PVC.

## 2.17 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded, zinc-coated steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  1. Indoor Applications: Zinc-coated or stainless steel.
  2. Outdoor Applications: Stainless steel.

## 2.18 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
  1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
  3. Hardware: Galvanized steel or polycarbonate.
  4. Accessories: Protection pads.

## 2.19 OUTDOOR EQUIPMENT STANDS

- A. Description: Individual foot supports with elevated adjustable channel cross bars and clamps/fasteners/bolts for ground or roof-supported outdoor equipment components, without roof membrane penetration, in a prefabricated system that can be modularly assembled on-site.
- B. Foot Material: Rubber or polypropylene.
- C. Rails Material: Hot-dip galvanized carbon steel.
- D. Wind/Sliding Load Resistance: Up to 100 mph minimum.

## 2.20 MISCELLANEOUS SUPPORT MATERIALS

- A. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

B. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

C. Threaded Rods: Continuously threaded. Zinc-plated steel or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar material as rods.

## 2.21 PIPING AND TUBING INSULATION

A. Comply with requirements in Section 230719 "HVAC Piping Insulation" for system piping insulation requirements.

## 2.22 SYSTEM CONTROL CABLE

A. Cable Rating: Listed and labeled for application according to NFPA 70.

1. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

- a. Flame Travel Distance: 60 inches or less.
- b. Peak Optical Smoke Density: 0.5 or less.
- c. Average Optical Smoke Density: 0.15 or less.

2. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

3. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

B. Low-Voltage Control Cabling:

1. Paired Cable: NFPA 70, Type CMG.

- a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
- b. PVC insulation.
- c. Braided or foil shielded.
- d. PVC jacket.
- e. Flame Resistance: Comply with UL 1685.

2. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

- a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.

- b. PVC insulation.
- c. Braided or foil shielded.
- d. PVC jacket.
- e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
- f. Flame Resistance: Comply with NFPA 262.

C. TIA-485A Network Cabling:

1. Standard Cable: NFPA 70, Type CMG.

- a. Paired, one pair or two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
- b. PVC insulation.
- c. Unshielded.
- d. PVC jacket.
- e. Flame Resistance: Comply with UL 1685.

2. Plenum-Rated Cable: NFPA 70, Type CMP.

- a. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
- b. Fluorinated ethylene propylene insulation.
- c. Unshielded.
- d. Fluorinated ethylene propylene jacket.
- e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
- f. Flame Resistance: NFPA 262.

D. Ethernet Network Cabling: TIA-568-C.2 Category 6 cable with RJ-45 connectors.

- 1. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of category cable indicated.
- 2. Conductors: 100-ohm, 23 AWG solid copper.
- 3. Shielding: Unshielded twisted pairs (UTP).
- 4. Cable Rating: By application.
- 5. Jacket: White thermoplastic.

E. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for cable raceways.

2.23 MATERIALS

A. Steel:

- 1. ASTM A36/A36M for carbon structural steel.
- 2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
  2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.
- C. Galvanized Steel: ASTM A653/A653M.
- D. Aluminum: ASTM B209.
- E. Comply with Section 230546 "Coatings for HVAC" for corrosion-resistant coating.
- F. Corrosion-Resistant Coating: Coat with a corrosion-resistant coating capable of withstanding a 3000-hour salt-spray test according to ASTM B117.
1. Standards:
    - a. ASTM B117 for salt spray.
    - b. ASTM D2794 for minimum impact resistance of 100 in-lb.
    - c. ASTM B3359 for cross-hatch adhesion of 5B.
  2. Application: Spray.
  3. Thickness: 1 mil.
  4. Gloss: Minimum gloss of 60 on a 60-degree meter.

## 2.24 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.
- D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.

- E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.
- F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.
- G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EQUIPMENT INSTALLATION, GENERAL

- A. Clearance:
  - 1. Maintain manufacturer's recommended clearances for service and maintenance.
  - 2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
  - 1. Loose components shall be installed by manufacturer's service representative or system Installer under supervision of manufacturer's service representative.

### 3.3 INSTALLATION OF INDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.
- C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.
- D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
- E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
- F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
- G. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.
- H. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.

- I. Floor-mounted units located in mechanical rooms.

### 3.4 INSTALLATION OF OUTDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 2. Grouting: Place grout under equipment supports and make bearing surface smooth.

### 3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Install sleeves for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230500 "Common Work Results for HVAC."
- L. Install escutcheons for piping and tubing penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230500 "Common Work Results for HVAC."

### 3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

#### A. General Requirements for Drain Piping and Tubing:

1. Install a union in piping at each threaded unit connection.
2. Install an adjustable stainless steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
  - a. Details indicated on Drawings.
  - b. Manufacturer's requirements.
  - c. Governing codes.
  - d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.

#### B. Gravity Drains:

1. Slope piping from unit connection toward drain termination at a constant slope of not less than one percent.

#### C. Pumped Drains:

1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

### 3.7 INSTALLATION OF REFRIGERANT PIPING

#### A. Refrigerant Tubing Kits:

1. Unroll and straighten tubing to suit installation. Deviations in straightness of exposed tubing shall be unnoticeable to observer.
2. Support tubing using hangers and supports indicated at intervals not to exceed 5 ft.. Minimum rod size, 1/4 inch.
3. Prepare tubing ends and make mating connections to provide a pressure tight and leak-free installation.

#### B. Install refrigerant piping according to ASHRAE 15 and governing codes.

- C. Select system components with pressure rating equal to or greater than system operating pressure.
- D. Install piping as short and direct as possible, with a minimum number of joints and fittings.
- E. Arrange piping to allow inspection and service of equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- F. Install refrigerant piping and tubing in protective conduit where installed belowground.
- G. Install refrigerant piping and tubing in rigid or flexible conduit in locations where exposed to mechanical damage.
- H. Unless otherwise required by VRF HVAC system manufacturer, slope refrigerant piping and tubing as follows:
  - 1. Install horizontal hot-gas discharge piping and tubing with a uniform slope downward away from compressor.
  - 2. Install horizontal suction lines with a uniform slope downward to compressor.
  - 3. Install traps to entrain oil in vertical runs.
  - 4. Liquid lines may be installed level.
- I. When brazing, remove or protect components that could be damaged by heat.
- J. Before installation, clean piping, tubing, and fittings to cleanliness level required by VRF HVAC system manufacturer.
- K. Joint Construction:
  - 1. Ream ends of tubes and remove burrs.
  - 2. Remove scale, slag, dirt, and debris from inside and outside of tube and fittings before assembly.
  - 3. Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
    - a. Use Type BCuP (copper-phosphorus) alloy for joining copper fittings with copper tubing.
    - b. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze.

### 3.8 INSTALLATION OF METAL HANGERS AND SUPPORTS

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.



- C. Comply with MFMA-103 for metal framing system selections and applications that are not specified.
- D. Fastener System Installation:
  - 1. Install powder-actuated fasteners, for use in lightweight concrete or concrete slabs less than 4 inches thick, in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
  - 3. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- E. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. Install building attachments within concrete slabs or attach to structural steel.
  - 1. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- L. Piping and Tubing Insulation:
  - 1. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
  - 2. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

- M. Horizontal-Piping Hangers and Supports: Install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  2. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  3. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  4. Multiple horizontal pipes located indoors may use metal framing systems with split clamp attachment for each pipe in lieu of individual clevis hangers.
  5. Pipe stands for horizontal pipes located outdoors.
  6. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  7. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- N. Horizontal Piping Hanger Spacing and Rod Size: Install hangers for drawn-temper copper piping with the following maximum horizontal spacing and minimum rod sizes:
1. Sizes through NPS 3/4: Maximum span, 5 ft.; minimum rod size, 1/4 inch.
  2. NPS 1: Maximum span, 6 ft.; minimum rod size, 1/4 inch.
  3. NPS 1-1/4: Maximum span, 7 ft.; minimum rod size, 3/8 inch.
  4. NPS 1-1/2: Maximum span, 8 ft.; minimum rod size, 3/8 inch.
  5. NPS 2: Maximum span, 8 ft.; minimum rod size, 3/8 inch.
  6. NPS 2-1/2: Maximum span, 9 ft.; minimum rod size, 3/8 inch.
  7. NPS 3 and Larger: Maximum span, 10 ft.; minimum rod size, 3/8 inch.
- O. Plastic Pipe Hanger and Support Spacing:
1. Space hangers and supports according to pipe manufacturer's written instructions for service conditions.
  2. Maximum spacing, 5 ft.; minimum rod size, 1/4 inch.
- P. Vertical-Piping Clamps: Install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8).
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): If longer ends are required for riser clamps.
- Q. Support vertical runs at roof, at each floor, and at midpoint intervals between floors, not to exceed 5 ft..
- R. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified.
- S. Use hangers, supports, and attachments with galvanized coatings unless otherwise indicated.
- T. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

- U. Trim excess length of continuous-thread hanger and support rods to 1 inch.
- V. Hanger-Rod Attachments: Install the following types:
  - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  - 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  - 3. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  - 4. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- W. Building Attachments: Install the following types:
  - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
  - 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  - 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  - 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  - 6. C-Clamps (MSS Type 23): For structural shapes.
  - 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  - 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  - 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  - 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  - 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  - 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
  - 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

### 3.9 INSTALLATION OF PIPING AND TUBING INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Installation to maintain a continuous vapor barrier.

B. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are unavailable, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

E. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.10 INSTALLATION OF DUCT, ACCESSORIES, AND AIR OUTLETS

- A. Where installing ductwork adjacent to equipment, allow space for service and maintenance.
- B. Comply with requirements for metal ducts specified in Section 233113 "Metal Ducts."
- C. Comply with requirements for air duct accessories specified in Section 233300 "Air Duct Accessories."
- D. Comply with requirements for flexible ducts specified in Section 233346 "Flexible Ducts."
- E. Comply with requirements for air diffusers specified in Section 233713.13 "Air Diffusers."
- F. Comply with requirements for registers and grilles specified in Section 233713.23 "Registers and Grilles."

3.11 ELECTRICAL CONNECTIONS

- A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.

- B. To extent electrical power is required for system equipment, components, and controls, and is not indicated on Drawings and addressed in the Specifications, the design for such electrical power shall be delegated to VRF HVAC system provider.
    - 1. Delegated design of electrical power to equipment, components and controls, and associated installation shall be included at no additional cost to Owner.
  - C. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.
  - D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
  - E. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding connections.
  - F. Install nameplate or acrylic label with self-adhesive back for each electrical connection indicating electrical equipment designation and circuit number feeding connection.
    - 1. Nameplate shall be laminated phenolic layers of black with engraved white letters. Letters at least 1/2 inch high.
    - 2. Locate nameplate or label where easily visible.
  - G. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or revised in this Section.
  - H. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems" for box selection and installation requirements for boxes as supplemented or revised in this Section.
  - I. Comply with requirements in Section 260533.23 "Surface Raceways for Electrical Systems" for wireways selection and installation requirements for wireways as supplemented or revised in this Section.
    - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
    - 2. Flexible metal conduit shall not be used.
  - J. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
  - K. Install manufactured conduit sweeps and long-radius elbows if possible.
  - L. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- 3.12 SOFTWARE
- A. Cybersecurity:

1. Software:
  - a. Coordinate security requirements with IT department.
  - b. Ensure that latest stable software release is installed and properly operating.
  - c. Disable or change default passwords to password using a combination of uppercase and lower letters, numbers, and symbols at least eight characters in length. Record passwords and turn over to party responsible for system operation and administration.
2. Hardware:
  - a. Coordinate location and access requirements with IT department.
  - b. Enable highest level of wireless encryption that is compatible with Owner's ICT network.
  - c. Disable dual network connections.

### 3.13 INSTALLATION OF SYSTEM CONTROL CABLE

#### A. Comply with NECA 1.

#### B. Installation Method:

1. Install cables in raceways except as follows:
  - a. Within equipment and associated control enclosures.
  - b. In accessible ceiling spaces where open cable installation method may be used.
  - c. In gypsum board partitions where cable may be enclosed within wall cavity.
2. Conceal raceway and cables except in unfinished spaces.

#### C. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable.
5. Cables serving a common system may be grouped in a common raceway. Install control cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles or access panels.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals.
15. Do not bend cables in a radius less than 10 times the cable OD.
16. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
17. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

D. Balanced Twisted-Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted-pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

E. Open-Cable Installation:

1. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
2. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources: Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded cable from potential EMI sources including electrical power wiring and equipment.

3.14 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.15 GROUNDING INSTALLATION

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

- B. For low-voltage control cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.16 IDENTIFICATION

- A. Identify system equipment, piping, tubing, and valves. Comply with requirements for identification specified in Section 230553 "Identification for HVAC Piping and Equipment."
- B. Identify system electrical and controls components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Identify each control cable on each end and at each terminal with a number-coded identification tag. Each cable shall have a unique tag.

### 3.17 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.
  - 1. Field service shall be performed by an employee or a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.
  - 2. Manufacturer shall provide on-site visits during the course of construction at installation milestones indicated. System Installer shall coordinate each visit in advance to give manufacturer sufficient notice to plan the visit.
    - a. First Visit: Kick-off meeting.
    - b. Second Visit: At approximately 25 percent completion of system(s).
    - c. Third Visit: At approximately 50 percent completion of system(s).
    - d. Fourth Visit: At approximately 75 percent completion of system(s).
    - e. Fifth Visit: Final inspection before system startup.
  - 3. Kick-off Meeting:
    - a. Meeting shall include system Installer and other related trades with sole purpose of reviewing VRF HVAC system installation requirements and close coordination required to make a successful installation.
    - b. Meeting shall be held at Project site and scheduled at a mutually agreed to time that occurs before the start of any part of system installation.
    - c. Meeting shall cover the following as a minimum requirement:
      - 1) Review of latest issue of Contract Documents, Drawings, and Specifications, relevant to VRF HVAC systems.
      - 2) Manufacturer's installation requirements specific to systems being installed.



- 3) Review of all relevant VRF HVAC system submittals, including delegated design submittals.
  - 4) Required field activities related installation of VRF HVAC system.
  - 5) Project team communication protocol, contact information, and exchange of responsibilities for each party involved, including manufacturer, supplier, system Installer, and other related trades.
4. Site Visits: Activities for each site visit shall include the following:
  - a. Meet with VRF HVAC system Installer to discuss field activities, issues, and suggested methods to result in a successful installation.
  - b. Offer technical support to Installer and related trades as related to VRF system(s) being installed.
  - c. Review progress of VRF HVAC system(s) installation for strict compliance with manufacturer's requirements.
  - d. Advise and if necessary assist Installer with updating related refrigerant calculations and system documentation.
  - e. Issue a report for each visit, documenting the visit.
    - 1) Report to include name and contact information of individual making the visit.
    - 2) Date(s) and time frames while on-site.
    - 3) Names and contact information of people meeting with while on-site.
    - 4) Clearly identify and list each separate issue that requires resolution. For each issue, provide a unique identification number, relevant importance, specific location or equipment identification, description of issue, recommended corrective action, and follow-up requirements needed. Include a digital photo for clarification if deemed to be beneficial.
5. Final Inspection before Startup:
  - a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according manufacturer's requirements and ready for final inspection.
  - b. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
  - c. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
  - d. Inspection reports for indoor units shall include, but not be limited to, the following:
    - 1) Unit designation on Drawings.
    - 2) Manufacturer model number.
    - 3) Serial number.
    - 4) Network address, if applicable.
    - 5) Each equipment setting.
    - 6) Mounting, supports, and restraints properly installed.

- 7) Proper service clearance provided.
- 8) Wiring and power connections correct.
- 9) Line-voltage reading(s) within acceptable range.
- 10) Wiring and controls connections correct.
- 11) Low-voltage reading(s) within an acceptable range.
- 12) Controller type and model controlling unit.
- 13) Controller location.
- 14) Temperature settings and readings within an acceptable range.
- 15) Humidity settings and readings within an acceptable range.
- 16) Condensate removal acceptable.
- 17) Fan settings and readings within an acceptable range.
- 18) Unit airflow direction within an acceptable range.
- 19) If applicable, fan external static pressure setting.
- 20) Filter type and condition acceptable.
- 21) Noise level within an acceptable range.
- 22) Refrigerant piping properly connected and insulated.
- 23) Condensate drain piping properly connected and insulated.
- 24) If applicable, ductwork properly connected.
- 25) If applicable, external interlocks properly connected.
- 26) Remarks.

e. Inspection reports for outdoor units shall include, but not be limited to, the following:

- 1) Unit designation on Drawings.
- 2) Manufacturer model number.
- 3) Serial number.
- 4) Network address, if applicable.
- 5) Each equipment setting.
- 6) Mounting, supports, and restraints properly installed.
- 7) Proper service clearance provided.
- 8) Wiring and power connections correct.
- 9) Line-voltage reading(s) within acceptable range.
- 10) Wiring and controls connections correct.
- 11) Low-voltage reading(s) within an acceptable range.
- 12) Condensate removal acceptable.
- 13) Noise level within an acceptable range.
- 14) Refrigerant piping properly connected and insulated.
- 15) Condensate drain piping properly connected and insulated.
- 16) Remarks.

f. Inspection reports for indoor, dedicated outdoor air ventilation units shall include, but not be limited to, the following:

- 1) Unit designation on Drawings.
- 2) Manufacturer model number.
- 3) Serial number.
- 4) Network address, if applicable.
- 5) Each equipment setting.

- 6) Mounting, supports, and restraints properly installed.
- 7) Proper service clearance provided.
- 8) Wiring and power connections correct.
- 9) Line-voltage reading(s) within acceptable range.
- 10) Wiring and controls connections correct.
- 11) Low-voltage reading(s) within an acceptable range.
- 12) Controller type and model controlling unit.
- 13) Controller location.
- 14) Temperature settings and readings within an acceptable range.
- 15) Humidity settings and readings within an acceptable range.
- 16) Condensate removal acceptable.
- 17) Fan settings and readings within an acceptable range.
- 18) Fan external static pressure setting.
- 19) Filter type and condition acceptable.
- 20) Noise level within an acceptable range.
- 21) Refrigerant piping properly connected and insulated.
- 22) Condensate drain piping properly connected and insulated.
- 23) Automatic dampers properly installed and operating.
- 24) Ductwork properly connected.
- 25) If applicable, external interlocks properly connected.
- 26) Remarks.

- g. Installer shall provide manufacturer with the requested documentation and technical support during inspection.
- h. Installer shall correct observed deficiencies found by the inspection.
- i. Upon completing the on-site inspection, manufacturer shall provide a written report with complete documentation describing each inspection step, the result, and any corrective action required.
- j. If corrective action is required by Installer that cannot be completed during the same visit, provide additional visits, as required, until deficiencies are resolved and systems are deemed ready for startup.
- k. Final report shall indicate the system(s) inspected are installed according to manufacturer's requirements and are ready for startup.

B. Perform the following tests and inspections with the assistance of manufacturer's service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Refrigerant Tubing Positive Pressure Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.2 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
4. Prepare test report to record the following information for each test:
  - a. Name of person starting test, company name, phone number, and e-mail address.
  - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
  - c. Detailed description of extent of tubing tested.
  - d. Date and time at start of test.
  - e. Test pressure at start of test.
  - f. Outdoor temperature at start of test.
  - g. Name of person ending test, company name, phone number, and e-mail address.
  - h. Date and time at end of test.
  - i. Test pressure at end of test.
  - j. Outdoor temperature at end of test.
  - k. Remarks:
5. Submit test reports for Project record.

D. Refrigerant Tubing Evacuation Testing:

1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour with no change.
4. Prepare test report to record the following information for each test:
  - a. Name of person starting test, company name, phone number, and e-mail address.
  - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
  - c. Detailed description of extent of tubing tested.
  - d. Date and time at start of test.
  - e. Test pressure at start of test.
  - f. Outdoor temperature at start of test.
  - g. Name of person ending test, company name, phone number, and e-mail address.
  - h. Date and time at end of test.
  - i. Test pressure at end of test.
  - j. Outdoor temperature at end of test.
  - k. Remarks:
5. Submit test reports for Project record.

6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.

E. System Refrigerant Charge:

1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
3. System refrigerant charging shall be witnessed by system manufacturer's representative.
4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.

F. Products will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.18 STARTUP SERVICE

A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.

1. Service representative shall be an employee or a factory-trained and -authorized service representative of VRF HVAC system manufacturer.
2. Complete startup service of each separate system.
3. Complete system startup service according to manufacturer's written instructions.

B. Startup checks shall include, but not be limited to, the following:

1. Check control communications of equipment and each operating component in system(s).
2. Check each indoor unit's response to demand for cooling and heating.
3. Check each indoor unit's response to changes in airflow settings.
4. Check each indoor unit, HRCU, and outdoor unit for proper condensate removal.
5. Check sound levels of each indoor and outdoor unit.

C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.

1. Installer shall correct deficiencies found during startup service for reverification.

D. System Operation Report:

1. After completion of startup service, manufacturer shall issue a report for each separate system.
2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.

3. Manufacturer shall electronically record not less than two hours of continuous operation of each system and submit with report for historical reference.
  - a. All available system operating parameters shall be included in the information submitted.

### 3.19 ADJUSTING

- A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
- C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.
- D. Occupancy Adjustments: When requested within 12 months from date of Final Acceptance, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.20 PROTECTION

- A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.
- B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.
- C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.
- D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

### 3.21 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Final Acceptance, maintenance service shall include 12 months' full maintenance by skilled employees of system Installer who are manufacturer's authorized service representative. Include two service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### 3.22 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Final Acceptance, service agreement shall include software support for two years.
- B. Upgrade Service: At Final Acceptance, update software to latest version. Install and program software upgrades that become available within two years from date of Final Acceptance. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### 3.23 DEMONSTRATION

- A. Engage a VRF HVAC system manufacturer's employed training instructor to train Owner's maintenance personnel to adjust, operate, and maintain entire system.
- B. Instructor:
  - 1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.
  - 2. Instructor's credentials shall be submitted for review by Owner before scheduling training.
  - 3. Instructor(s) primary job responsibility shall be Owner training.
  - 4. Instructor(s) shall have not less than three years of training experience with VRF HVAC system manufacturer and past training experience on at least three projects of comparable size and complexity.
- C. Schedule and Duration:
  - 1. Schedule training with Owner at least 20 business days before first training session.
  - 2. Training shall occur before Owner occupancy.
  - 3. Training shall be held at mutually agreed date and time during normal business hours.
  - 4. Each training day shall not exceed eight hours of training. Daily training schedule shall allow time for one-hour lunch period and 15-minute break after every two hours of training.
  - 5. Perform not less than eight total hours of training.
- D. Location: Owner shall provide a suitable on-site location to host classroom training.
- E. Training Attendees: Assume three people.
- F. Training Attendance: For record purposes, document training attendees at the start of each new training session. Record attendee's name, signature, phone number, and e-mail address.
- G. Training Format: Individual training modules shall include classroom training followed by hands-on field demonstration and training.

- H. Training Materials: Provide training materials in electronic format to each attendee.
  - 1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
  - 2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.
- I. Acceptance: Obtain Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION 238129





## SECTION 260000 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 GENERAL

#### 1.1 SCOPE OF WORK

- A. The work covered by this Division shall include furnishing all labor, materials, equipment, and services, and performing all operations required for the complete installation of the electrical systems of various kinds as specified below, shown on the drawings, and as required by Modifications as defined in the General Conditions. Work included in this Division is an integral part of these specifications and is subject to all applicable provisions of General Conditions and modifications thereof.

#### 1.2 INTENT

- A. The intent of this Division is to provide complete and operating electrical systems installed in a neat and workmanlike manner ready for use upon approval.
- B. This Division shall include all items required to make the working installation complete according to evident intent whether or not specifically mentioned in the specifications or shown on the drawings. Specification sections within this Division are not intended to define the limits of Subcontracts unless specifically stated otherwise.

#### 1.3 CODES

- A. Complete installation shall be in accordance with state and local building codes, ordinances, regulations, interpretations by authorities having jurisdiction and in accordance with the latest edition of the National Electrical Code as a minimum.
- B. Specifications and drawings shall supersede codes only where in excess of code requirements.
- C. Permits and Inspections:
  - 1. The CONTRACTOR shall obtain from the authority having jurisdiction the required construction permits and shall arrange at the proper time for all inspection by such authority.
  - 2. Two copies of a certificate of approval from the State and/or Local Electrical Inspector shall be delivered to the ENGINEER prior to final acceptance of the work.

#### 1.4 DRAWINGS

- A. The drawings are generally diagrammatic, but the installation shall be made substantially therewith. Scaling of plans for outlet and equipment locations is not accurate enough for the intent of these specifications. It is the CONTRACTOR's responsibility to comply with the evident intent

and to coordinate equipment locations. Where dimensions are shown on drawings or specified, they shall be verified on the job by the CONTRACTOR.

#### 1.5 RECORD DRAWINGS

- A. The CONTRACTOR shall neatly and legibly record on a set of plans used for no other purpose all approved changes, the actual routing of feeders and circuits, and the final coordinated location of equipment and outlets and shall deliver this "as built" set of plans to the ENGINEER.

#### 1.6 COORDINATION

- A. The CONTRACTOR shall verify and check all measurements in the field and be responsible for proper fitting together of all electrical work. He shall procure complete drawings and specifications on all coincident construction and fit the Electrical work in with it. He shall cooperate with other trades to achieve well-coordinated progress and final result and avoid conflicts with other trades. He shall make minor moves and changes necessary to accommodate other equipment without claim for extra payment. Drawings indicate approximate equipment capacity and approximate location of connection. This CONTRACTOR shall determine the exact characteristics of equipment actually being supplied; and provide proper connections, conductors, and protection.
- B. Should there be any doubt as to the spacing intent, location, or capacity of equipment; the CONTRACTOR shall have the point clarified by the ENGINEER before proceeding with the installation. Discrepancies shown on different plans, or between plans and actual field conditions, or between plans and specifications shall promptly be brought to the attention of the ENGINEER for a decision.

#### 1.7 SITE INSPECTION

- A. The CONTRACTOR will be held to have visited the site of the work and satisfied himself as to the conditions under which the work is to be performed. Existing construction, equipment and conditions where indicated are substantially correct; however, they shall be verified by each CONTRACTOR prior to submission of his proposal. No allowance will be made for lack of knowledge of existing conditions.
- B. The CONTRACTOR shall visit the project site prior to submitting a bid, to verify all field conditions. The bid price shall include the cost of all work required, whether indicated on the plans or not, to provide a complete and operational system. Any discrepancies between actual field conditions and the bid documents shall be brought to the attention of the ENGINEER no later than 72 hours prior to bid opening.

#### 1.8 EXCAVATING AND BACKFILLING

- A. The Electrical CONTRACTOR shall do all trenching and backfilling required for installation of electrical work. Particular care shall be taken not to disturb or damage work of other Contractors.

- B. Trenching and shoring shall comply with requirements of North Carolina State Department of Labor's regulations entitled "Safeguards During Construction" and "Trenching and Shoring".
- C. In backfilling conduit trenches, approved fill shall first be compacted firmly and evenly on both sides of underground conduit or duct banks in 6" layers to a depth of 12" over the top. Remainder of trench shall be backfilled to established grade in 6" layers. Compact density at optimum moisture content. Excess earth shall be distributed on premises as directed.
- D. Material to be excavated is assumed to be earth and other materials that can be removed with a power shovel. If rock is encountered within limits of excavation, the CONTRACTOR shall immediately notify the ENGINEER and shall not proceed further until instructions are given and measurements made for the purpose of establishing volume of rock excavation. Authority to proceed and confirmation of quantities shall be in writing if claims for extra costs based on unit prices are to be made.

#### 1.9 PROTECTION AND CLEAN-UP

- A. Properly protect work during its erection and until completion. Protect finished surfaces.
- B. Repair, clean, and touch-up, or replace all damaged material. At the completion of the project, remove all dust from finished surfaces.

#### 1.10 MATERIALS AND EQUIPMENT

- A. All materials shall be new and shall conform to the standards of the National Electrical Manufacturers Association and/or the American National Standards Institute for the use intended where a standard for such material and use exists.
- B. All materials, manufactured items, fabricated assemblies, and systems shall be approved, labeled and/or re-examination listed by a nationally recognized independent testing laboratory in every case where such approval, label or listing has been established for the particular type of device, assembly or system. The nationally recognized independent testing laboratory shall be one or more of the following:
  - 1. Underwriters Laboratories, Inc.
  - 2. Factory Mutual Engineering Corporation
  - 3. Electrical Testing Laboratories, Inc.
- C. Catalog numbers and trade names in these specifications and drawings describe the materials, devices, and equipment upon which the overall electrical design is based. The phrase "or approved equal" shall mean that similar material of equal quality, capacity and character that will perform the duties imposed by the overall design may be substituted only if properly submitted to and approved by the ENGINEER in writing.
- D. Any substitute materials installed, that have not been approved in writing, will be done at the CONTRACTOR's risk and will be subject to removal from the system at any stage of construction and replaced with that specified, and any damage done to other trades shall be made good.

- E. Incidental material and equipment required to complete the installation but not specified by make shall be first class products of a reputable manufacturer regularly engaged in the production of the required type of equipment and shall be the manufacturer's latest approved design.
- F. Equipment and materials of the same general type shall be of the same make throughout the work.
- G. Equipment and materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection by the ENGINEER until installed. All items subject to moisture damage (such as controls) shall be stored in dry, heated spaces.

#### 1.11 SHOP DRAWINGS AND SUBMITTALS

- A. Within 15 days after the date of award of contract, submit a complete list in quadruplicate of materials proposed for installation, and names of specialty contractors to the ENGINEER for approval. Clearly indicate all substitute materials. Upon approval of the list, the ENGINEER will indicate those for which submission of shop drawings, cuts, descriptive literature, and/or samples are required; and these items will not be considered to be approved until such supplementary data is approved. Intent to use exact material specified does not relieve the CONTRACTOR of responsibility for submitting a list and mention of several manufacturers for any item will not be acceptable.
- B. Shop drawings shall be prepared specifically for this job and shall be clearly identified to include all the items, features, and ratings specified or called for on the drawings. Manufacturer's standard catalog sheets and typical drawings alone are not acceptable, but when used to supplement detailed submittals they shall clearly indicate which of the standard features apply to this job. The CONTRACTOR must check and mark his approval on all submissions before the ENGINEER will check them.
- C. Shop drawings marked "Revise and Resubmit" do not give authority to proceed with any portions of the work shown thereon. Shop drawings submitted and returned marked "Approved as Noted" give authority to proceed in accordance with notes, but corrected drawings must be submitted. Only drawings approved without notes shall be used for erection work in the field.
- D. Submission of shop drawings, cuts, and descriptive literature shall be made in sufficient quantity to permit the retention by the ENGINEER of two copies.

#### 1.12 MANUALS AND INSTRUCTIONS

- A. The CONTRACTOR shall provide three bound copies of all maintenance and instructions manuals, parts lists, and connection diagrams for all systems and equipment requiring periodic and regular maintenance. Include in each manual a list of names, addresses, and telephone numbers of local servicing agencies maintaining parts stocks and authorized to make necessary repairs and/or adjustments to the equipment furnished under this division.
- B. The CONTRACTOR shall conduct classes for Owner's personnel in the proper operation and adjustment of the systems. Schedule classes in coordination with Owner's personnel. Obtain signatures of participants on a dated form and include with manuals.

### 1.13 EQUIPMENT CONNECTIONS

- A. The connection of all equipment requiring electrical connections shall be provided as part of the work of this Division, unless otherwise indicated or specified. Special outlets, where indicated, are considered to be the electrical connection to the equipment. Required disconnects shall be furnished and installed by the electrical CONTRACTOR in accordance with code requirements whether or not specifically shown on the drawings.
- B. For all power equipment provided by other contractors, the electrical CONTRACTOR shall provide all necessary power wiring not factory installed as a part of the equipment. Motors shall be connected for proper rotation. Unless otherwise noted on drawings, controllers will be furnished by the CONTRACTOR furnishing the power equipment, and these controllers will be installed, and power wiring connected to them by the electrical CONTRACTOR. Unless otherwise indicated, control wiring will be by the CONTRACTOR supplying the equipment to be controlled.
- C. For all equipment requiring electrical services other than mentioned above, the electrical CONTRACTOR shall make final connections to terminals in or on the equipment including control wiring where shown on drawings. These connections shall be made from junction boxes, switches, conduit stubs, and/or control devices as indicated on the drawings, which comply with requirements of the manufacturer of the equipment specified.

### 1.14 SYSTEM IDENTIFICATION

- A. All equipment scheduled below shall be properly identified with an engraved white core black phenolic name plate. Printed labels with plastic tape will not be accepted. Attach plates with sheet metal screws.
- B. Disconnects
  - 1. Labels
    - a. Equipment served
    - b. Circuit number
    - c. Voltage and phase
- C. Panelboards, Switchboards and Motor Control Centers:
  - 1. Label
    - a. Designation letter and numbers
    - b. Voltage and phase
    - c. Equipment served by each switchboard breaker or motor control center combination starter

1.15 TESTS

- A. Conduct tests during progress of electrical work. Upon completion, thoroughly test and adjust all apparatus and equipment and leave same in proper operating condition. Check balance of loads on each leg or phase of the electrical system and remedy all defects. When directed by the ENGINEER, perform Meggar Test of system. Replace conductors with low insulation resistance and demonstrate by further test that the fault has been eliminated.
- B. The CONTRACTOR shall conduct final operating tests of all completed systems including final adjustments of field adjustable components. He shall record all results and settings on forms provided by the manufacturer of the system for the purpose of final check-out and leave all systems in proper operating condition. See individual sections for additional test requirements.

1.16 TEMPORARY FACILITIES

- A. The electrical CONTRACTOR shall be responsible for all temporary facilities required for completion of the work of this division.
- B. He shall provide adequate weatherproof storage for all material subject to moisture damage. Temporary structures shall be built in a sound and waterproof manner.

1.17 ELECTRICAL SERVICES

- A. Provide complete 480Y/277V 3-phase, 4-wire electrical service in accordance with utility requirements and the drawings. Any charge by the electric utility for their portion of the work is to be included in the contract price.
- B. Service equipment for the emergency electrical system shall include a diesel engine driven 480Y/277V generator with all accessories specified and/or indicated on the drawings and any other systems derived from the 480Y/277V emergency electrical system.

1.18 BASIC METHODS AND MATERIALS

- A. Wiring Methods
  - 1. Unless otherwise indicated or specified, the wiring method shall consist of insulated wires installed in metal raceways. See "RACEWAYS" and "WIRES" below.
  - 2. The word "conduit" (or abbreviation "C") used herein or on the drawings indicates Rigid Metal Conduit and, where permitted or required, Liquid-Tight Flexible Metal Conduit, Schedule 40 PVC Conduit or Intermediate Metal Conduit.
  - 3. Pulling lubricants manufactured specifically for conductor lubrication and approved for the type conductors installed shall be used to facilitate pulling conductors into conduits.

## PART 2 - PRODUCTS

### 2.1 FOUNDATIONS

- A. Provide all concrete foundations indicated on drawings for equipment installed under this division. Construct all foundations in strict accordance with recommendations of manufacturer of equipment which is to be installed thereon as indicated on drawings. Provide all required foundation bolts, channels, washers, sleeves, plates, templates, etc.
- B. Foundation bolts shall be embedded in concrete, set in place before concrete is poured and securely held in place with templates. Concrete foundations shall develop a minimum strength of 3,500 psi at 28 days. All concrete foundations shall have all exposed surfaces steel troweled smooth and with beveled edges. Set all equipment on their foundations and shim level with steel shims and grout up under base for uniform bearing. All equipment shall be so installed and shall so operate that no noise or vibration is transmitted to any part of building beyond room or rooms in which equipment is located.

### 2.2 MISCELLANEOUS STEEL

- A. Provide miscellaneous structural steel necessary to mount electrical equipment. All structural steel shall be "Structural Quality" conforming to A.S.T.M. A-36, and shall be standard shapes and sizes free from rust and/or scale. Steel shall be firmly and rigidly welded or bolted in place, and where exposed to the weather shall be galvanized after all cutting, drilling and/or welding is done. All shop connections shall be welded or riveted and all field connections shall be bolted on all outdoor structures. Where field cutting or drilling of galvanized steel is necessary, the CONTRACTOR shall apply one coat of aluminum and oil paint.

### 2.3 GROUNDING

- A. All electrical equipment, metal raceways, non-current carrying parts, the metal water piping system, if metallic, and the identified neutral conductor shall be permanently and effectively grounded in accordance with article 250 of N.E.C.
- B. Grounding electrode conductors shall run in rigid conduit to the grounding electrode system. Connection to the grounding electrode system shall be made with an approved clamp connecting the conduit and the conductor to the electrode.
- C. All grounding conductors shall be copper as shown on drawings.
- D. All grounding conductors shall be copper. Unless otherwise indicated all raceways shall contain a green insulated equipment grounding conductor.

### 2.4 RACEWAY SYSTEMS

- A. Raceway sizes that are not indicated on the drawings shall be determined by the CONTRACTOR in accordance with N.E.C. requirements for type insulation used, except that raceways shall be of



¾-inch minimum size. Exposed conduit above grade shall be galvanized rigid metal to protect against corrosion. Below grade conduit shall be Sch 40 PVC.

- B. Conduits shall be protected against the entry of dirt or trash. All bends shall be made with standard conduit elbows or conduit bent to not less than the same radius of a standard conduit elbow. Conduits shall be supported at intervals not greater than 8 feet and within 3 feet of any bend, cabinet, outlet, or junction box. Conduits shall be supported by approved pipe straps or clamps. Fittings shall be by T&B, Steel City, Raco or O.Z. T&B Catalog numbers are used; however, approved equal products of the other named manufacturers are acceptable.
- C. All conduit terminations, including stub outs, shall provide protection for conductor insulation. Terminations in other than threaded hubs of boxes or equipment shall include insulating bushings for rigid conduit.
- D. Rigid steel conduit shall be standard weight, mild steel pipe, hot-dipped galvanized, sherardized or zinc-coated conforming to the requirements of ANSI C 80.1-1966 or later edition. Termination at sheet metal enclosures shall consist of double locknuts and T&B Series 200 insulating bushings.
- E. Conduit installed underground or under slabs on grade shall be Schedule 40 PVC, or plastic coated rigid galvanized steel as shown. Underground conduit shall be installed a minimum of 24" below finished grade. Where Schedule 40 PVC is installed, the elbows required to turn the raceway up into cabinets, equipment etc., shall be rigid steel. A copper ground wire shall be installed in all PVC conduits. Rigid steel conduit shall have PVC coating with a minimum 15 mils thickness.
- F. Liquid-tight flexible metal conduit shall be zinc-coated steel with PVC jacket. Connectors shall be T&B Series 5300 insulated type. Liquid-tight flexible conduit in sizes ½-inch through 2½ inches shall be used for connection to motors, and all moving or vibrating apparatus.

## 2.5 DEVICE, JUNCTION, AND PULL BOXES

### A. Exposed Work, Interior Locations

- 1. Boxes in locations requiring rigid conduit shall be products of Crouse-Hinds. Lighting outlets shall be #GRF29-A "Condulet." Device outlets shall be FS series "Condulets" with matching covers as required for the type of device indicated. If space is required, use FD series "Condulets".
- 2. Boxes 5-inch square or larger, auxiliary gutters and troughs shall be N.E.C. gauge, galvanized steel fitted with screw attached cover.

### B. Exposed Work, Exterior Locations

- 1. Boxes in locations requiring PVC-coated rigid conduit shall be products of Crouse-Hinds. Lighting outlets shall be #GRF29-A "Condulet." Device outlets shall be FS series "Condulets" with matching covers as required for the type of device indicated. If space is required, use FD series "Condulets."
- 2. Boxes, auxiliary gutters and troughs exposed in exterior locations shall be N.E.C. gauge, stainless steel fitted with screw attached cover.

C. Boxes for Equipment Connections

1. Junction boxes indicated for equipment connections shall be recessed or surface mounted to conform to other outlets in the area, and shall be sized as required. Boxes shall be furnished with cover and fittings, etc., necessary for final connections to the equipment.

2.6 WIRES

A. 600V and Below

1. See "Wiring Methods" above. Unless otherwise indicated or specified, all wires shall be copper. All wires #8 and larger shall be stranded. Wires shall be products of Triangle, Okonite, Southwire, or approved equal, and shall be factory marked not over 2' on centers, indicating size, type, voltage, and manufacturer's name. All wires #6 and smaller shall have color coded insulation. All wires #4 and larger shall be color coded but at the CONTRACTOR's option the colors may be a permanent type colored tape which shall be applied to the entire length of the wires exposed in panels and outlets, etc.
2. All wires #8 larger shall have THW insulation. Smaller wires shall have THHN/THWN insulation.
3. Wires sizes shall be A.W.G. sizes as indicated on the drawings. No wires for power or lights shall be smaller than #12.
4. All wires for feeders, branch circuits, switch legs, and power wiring, shall be color coded as follows:

480/277 V System Wiring		240/120 V System Wiring	
Phase "A"	Brown	Phase "A"	Black
Phase "B"	Orange	Phase "B"	Red
Phase "C"	Yellow	Phase "C"	Blue
Neutral	Gray	Neutral	White
Ground wires	Green	Ground wires	Green

5. Conductors, in all cases, shall be continuous from outlet to outlet and no splicing shall be made except within outlet or junction boxes, troughs and gutters. Solid conductors, namely size #10, #12 AWG copper, and smaller shall be spliced by twisting securely and by means of hot-dipped solder plus gum rubber tape, plus friction tape, or plastic tape approved as a substitute for friction tape. The CONTRACTOR shall use Ideal "Wire-nuts" for recessed lighting fixture lead splices to branch circuit conductors. As an option, instead of solder and tape, the CONTRACTOR may use Ideal "Wing-nut" or T&B "Piggy" connectors for branch circuit splices (#10 and #12) in junction boxes and light fixtures, except recessed fixtures as noted above. Stranded conductors, namely #8 AWG copper and larger, shall be spliced by approved mechanical connectors plus gum tape, plus friction or plastic tape. Solderless mechanical connectors, for splices and taps provided with U.L. approved insulating covers, may be used instead of mechanical connectors plus tape.

2.7 SWITCHING, PROTECTION, AND DISTRIBUTION EQUIPMENT

A. General

1. Equipment shall be manufactured by Allen Bradley, Siemens, Cutler Hammer, General Electric or Square D installed in NEMA enclosures suitable for environment in which applied. Service Equipment shall be labeled with Underwriters Laboratories, Inc. "Service Entrance" label whenever such label service is available for type of equipment required. Type designations are Square D or Cutler Hammer as indicated on drawings.
2. Switching and protective devices shall provide automatic and manual operation unless noted otherwise. They shall have quick-make, quick-break mechanism with external operating handle, and where individually mounted shall be mechanically interlocked with enclosure cover to provide normal access to inside of enclosure when disconnect is in "OFF" position only. Individually mounted switching and protective devices in enclosures suitable for the environment shall have the "open" and "closed" positions designated on the cover with provisions for locking in either position, and shall have a neutral bar for terminating the neutral conductor where applicable.

B. Safety Switches

1. Shall be NEMA type heavy-duty H.P. rated for 600 volts as required. Switches shall be non-fusible or fusible as shown on Drawings. Where fusible, switches shall use time delay, dual-element, non-renewable, cartridge type fuses. Current limiting fuses shall be Class R. Fuses shall be manufactured by Bussman or Chase-Shawmut. Enclosures NEMA 3R outdoors unless otherwise indicated.

C. Circuit Breakers

1. Molded case breakers shall be thermal magnetic type trip-free having trip indication independent of handle "on," "off" positions. Multiple breakers shall be common trip. Circuit breakers shall be bolted in place. Individual enclosures shall be NEMA 1A, unless otherwise indicated. Breakers shall be calibrated at 40°C. or ambient compensated. Ampere ratings, frame sizes and other breaker characteristics shall be as indicated on the drawings.

D. Panelboards

1. Panelboards shall be dead front, circuit breaker type, installed in cabinets as specified below; with lugs only in the mains except where main breakers are indicated. See "Panelboard Schedules" on drawings for requirements other than specified below.
2. Each panelboard shall contain a complete and accurate typewritten circuit schedule mounted on back of door.

E. Bus Bar

1. Bus bars shall be copper.

F. Dry Type Transformers

1. Provide dry type transformers of KVA sizes as noted on the Drawings. Unless otherwise shown on Drawings transformers shall be Cutler Hammer type EP, EPT, DS-3, or DT-3, as applicable; or approved equal products of General Electric or Square D.
2. All transformers shall have standard taps. Transformers 30 KVA and smaller shall have at least the equivalent of 2-5% FCBN taps.

3. Transformers rated 3 KVA thru 15 KVA shall have Class H insulation and be designed not to exceed 115°C rise above a 40° ambient under the above full load conditions.

END OF SECTION 260000



## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Copper building wire rated 600 V or less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

#### 1.3 DEFINITIONS

- A. VFC: Variable-frequency controller.
- B. Division 21: Fire suppression (sprinkler) contractor.
- C. Division 23: Mechanical contractor.
- D. Division 26: Electrical contractor.
- E. Division 28: Fire Alarm contractor.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.
- C. Test Results: Submit a copy of electrical continuity and short circuit test results for feeders, sub-feeders and service conductor cables to the Engineer of Record and the Owner. Retain results amongst the project Record Documents for NC State Construction Office inspection upon Final Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and use.
  - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- D. Conductor Insulation:
  - 1. Type THHN and Type THWN-2: Comply with UL 83.
  - 2. Type XHHW-2: Comply with UL 44.

### 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment , and marked for intended location and use.

### 2.3 DIVISION OF WORK

- A. All individual motor starters and drives for mechanical equipment (fans, pumps, etc.) shall be furnished and installed under Division 23. Power wiring to mechanical equipment shall be provided under Division 26 up to a termination point consisting of a junction box, trough, starter, VFC or disconnect switch. Line side terminations shall be provided under Division 26. Wiring from the termination point to the mechanical equipment, including final connections, shall be provided under Division 23.
- B. Duct smoke detectors, if provided per NFPA 90A requirements, shall be furnished and wired by Division 28; installed by Division 23. Fire alarm AHU shut down circuits shall be wired from the Fire Alarm Control Panel to a termination point, adjacent to the AHU control, under Division 28. AHU control wiring from the termination point to the equipment shall be under Division 23.

- C. Equipment less than 120 Volt, all relays, actuators, timers, seven-day clocks, alternators, pressure, vacuum, float, flow, electro-pneumatic switches, aquastats, freeze-stats, line and low voltage thermostats, thermals, remote selector switches, remote push-button stations, emergency break-glass stations, interlocking, disconnect switches beyond termination point, and other appurtenances associated with equipment under Division 23 shall be furnished, installed and wired under Division 23.
- D. All wiring required for controls and instrumentation not indicated on the Drawings shall be furnished and installed by Division 23 contractor; including for all VFC driven equipment where such cabling shall consist of 3-phase, 3-ground, copper tape spiral shield, galvanized steel interlocked armor cable.
- E. Roof exhaust fans with built-in disconnects provided under Division 23, or doors provided with built-in outlets shall be wired under Division 26 to the line side of the disconnect switch or outlet. A disconnect switch shall be provided under Division 26 if the fan is not provided with a built-in disconnect switch. In this case wiring from the switch to the fan shall be under Division 23. Built-in switches for roof top equipment shall be in NEMA 3R enclosures.
- F. Sprinkler flow and tamper switches shall be furnished and installed under Division 21, and wired under Division 28.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. All electrical work shall be performed by a company or companies properly licensed by the NC State Electrical Board of Examiners.

#### 3.2 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; Class B stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; Class B stranded for No. 8 AWG and larger.
- C. VFC Output Circuits Cable: VFC cable shall be provided by the Division 23 Contractor for all VFC driven equipment where such cabling shall consist of 3-phase, 3-ground, copper tape spiral shield, galvanized steel interlocked armor cable. To ensure system reliability, cable shall be terminated in a connector designed exclusively for ASD/VFC cable.
- D. Power-Limited Fire Alarm and Control: Stranded copper conductors.
- E. Conductor Sizes for Power and Lighting Circuits: #12 AWG minimum and 500 KCMIL maximum.



3.3 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductor in raceway.
- B. Exposed Feeders: Dual-rated type THHN/THWN or XHHW, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Dual-rated type THHN/THWN or XHHW, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Dual-rated type THHN/THWN or XHHW, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Dual-rated type THHN/THWN or XHHW, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.
- H. VFC Output Circuits: VFC cable shall be provided by the Division 23 Contractor for all VFC driven equipment where such cabling shall consist of 3-phase, 3-ground, copper tape spiral shield, galvanized steel interlocked armor cable. To ensure system reliability, cable shall be terminated in a connector designed exclusively for ASD/VFC cable.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. All power conductors are to be run in raceway. Install cables above drop ceilings parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- F. Size conductors for branch circuits to prevent a voltage drop exceeding three percent (3%) at the farthest outlet of power, heating and lighting loads, or any combination of such loads. The

maximum total voltage drop on both feeders and branch circuits to the farthest outlet shall not exceed five percent (5%).

- G. Where the conductor length from the panel to the first outlet on a 120V circuit exceeds 50-feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.
- H. Where the conductor length from the panel to the first outlet on a 277V circuit exceeds 125-feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG.

### 3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

### 3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### 3.9 SPLICING

- A. Joints in solid conductors shall be spliced using Ideal “wrenuts”, 3M Company “Scotchlock” or T&B connectors in junction boxes, outlet boxes and lighting fixtures.
- B. “Sta-kon” or other permanent type crimp connectors shall not be used for branch circuit connections.
- C. Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with U.L.-approved insulating covers, may be used instead of mechanical connectors plus tape.
- D. In all cases, conductors shall be continuous from outlet to outlet and no splicing shall be made except within outlet or junction boxes, troughs and gutters.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment to perform tests and inspections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test feeders, sub-feeders and service entrance conductors for compliance with requirements.
  - 2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression-applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
  - 3. Initial Infrared Scanning: After Project Acceptance, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and

equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

- a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
  - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Cables will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519



## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - a. Plans showing as-built, dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
    - 1) Test wells.
    - 2) Ground rods.
    - 3) Ground rings.
    - 4) Grounding arrangements and connections for separately derived systems.
  - b. Instructions for periodic testing and inspection of grounding features at test wells, ground rings, and grounding connections for separately derived systems based on NETA MTS and NFPA 70B.
    - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
    - 2) Include recommended testing intervals.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### 2.2 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  1. Solid Conductors: ASTM B 3.
  2. Stranded Conductors: ASTM B 8.
  3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart.

## 2.3 CONNECTORS

- A. Listed and labeled by third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.
- J. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- K. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- L. Straps: Solid copper, copper lugs. Rated for 600 A.
- M. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- N. Water Pipe Clamps:
  1. Mechanical type, two pieces with stainless-steel bolts.
    - a. Material: Tin-plated aluminum.
    - b. Listed for direct burial.



2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

## 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 20 feet. All ground connections shall be accessible.
- B. Grounding electrode conductor #4 AWG and larger shall be installed in raceway system.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
  1. Bury at least 24 inches below grade.
  2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  2. Identify each grounding electrode connected to the common ground bus.
- D. Conductor Terminations and Connections:
  1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  3. Connections to Ground Rods at Test Wells: Bolted connectors.
  4. Connections to Structural Steel: Welded connectors.
- E. Boxes with concentric, eccentric or over-sized knockouts shall be provided with bonding bushings and jumpers sized per NEC Article 250 and lugged to the box.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

B. The electrical service shall be grounded by a minimum of three (3) means:

1. To the metallic cold-water pipe, as per NEC Article 250.
2. To the steel frame of the building.
3. To ground rods.

### 3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Handholes: Install a driven ground rod through handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before handhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Pad-Mounted Transformers: Comply with Utility grounding requirements.

### 3.4 EQUIPMENT GROUNDING

A. Install solid green colored insulated equipment grounding conductors with all feeders and branch circuits.

B. Conductors intended as neutral shall be colored solid white on 120/208V circuits.

C. Raceway systems shall not be relied on for ground continuity. A green grounding conductor, properly sized per the NEC shall be run in all raceways except for telecommunications, data, and audio systems. Equipment ground conductor size shall proportionately be increased in size when ungrounded circuit conductors are upsized for voltage drop.

D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

### 3.5 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. Use exothermic welds for all below-grade connections.
  - 3. For grounding electrode system, install at least three rods spaced at least two-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
  - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. The gas piping system shall be bonded to the equipment ground as required per the Gas Code Section 309.1. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building.
  - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
  - 2. Bury ground ring not less than 24 inches from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
  - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
  - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- K. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
  - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Pad-Mounted Equipment: 5 ohms.
6. Handhole Grounds: 10 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Conduit and cable support devices.
4. Support for conductors in vertical conduit.
5. Structural steel for fabricated supports and restraints.
6. Mounting, anchoring, and attachment components, including mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
7. Fabricated metal equipment support assemblies.

#### 1.3 ACTION SUBMITTALS

- A. Shop Drawings: Signed and sealed by a qualified Professional Engineer licensed in the State of North Carolina. For fabrication and installation details for electrical hangers and support systems.
  1. Hangers. Include product data for components.
  2. Slotted support systems.
  3. Equipment supports.
  4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Suspended ceiling components.
  2. Ductwork, piping, fittings, and supports.

3. Structural members to which hangers and supports will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
  - a. Luminaires.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Access panels.
  - e. Projectors.

- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.

## 1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2/D1.2M.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
  2. Component Importance Factor: 1.5.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. Identify products with appropriate markings of applicable testing agency.
  1. Flame Rating: Class 1.
  2. Self-extinguishing according to ASTM D 635.

### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
  1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  2. Material for Channel, Fittings, and Accessories: Galvanized steel.
  3. Channel Width: Selected for applicable load criteria.

4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  2. Channel Material: 6063-T5 aluminum alloy.
  3. Fittings and Accessories Material: 5052-H32 aluminum alloy.
  4. Channel Width: Selected for applicable load criteria.
  5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
  2. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  3. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  4. Toggle Bolts: All-steel springhead type.
  5. Hanger Rods: Threaded steel.
  6. Powder actuated fasteners are not allowed.

## 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.



## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA 101
  - 3. NECA 105.
  - 4. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To New Concrete: Bolt to concrete inserts.
  2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  3. To Light Steel: Sheet metal screws.
  4. 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base as follows:
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
3. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

#### 1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
- C. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
  - 1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
  - 2. GRC: Comply with ANSI C80.1 and UL 6.
  - 3. IMC: Comply with ANSI C80.6 and UL 1242.
  - 4. EMT: Comply with ANSI C80.3 and UL 797.
  - 5. FMC: Comply with UL 1; zinc-coated steel.
  - 6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- B. Metal Fittings:
  - 1. Comply with NEMA FB 1 and UL 514B.
  - 2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
  - 3. Fittings, General: Listed and labeled for type of conduit, location, and use.
  - 4. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: compression.
  - 5. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

6. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

### A. Nonmetallic Conduit:

1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
2. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

### B. Nonmetallic Fittings:

1. Fittings, General: Listed and labeled for type of conduit, location, and use.
2. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
3. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
  1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Screw-cover type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover where applicable.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
  - 1. Material: sheet metal.
  - 2. Type: Semi-adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
  - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.

## 2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

### A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.

### B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC" or "TELECOMMUNICATIONS".
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

### C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

1. Standard: Comply with SCTE 77.
2. Color of Frame and Cover: Gray or green, depending on installation location (sidewalk, grass, etc.).
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC" or "TELECOMMUNICATIONS".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.



## 2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Tests of materials shall be performed by an independent testing agency.
  - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer licensed in the State of North Carolina shall certify tests by manufacturer.
  - 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC.
  - 2. Concealed Conduit, Aboveground: GRC.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC or Type EPC-80-PVC either direct buried or concrete encased; depending on application.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 5. Boxes and Enclosures, Aboveground: NEMA 250, or Type 4X.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
    - a. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - b. Mechanical rooms.
  - 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations, with green ground wire installed per the NEC.
  - 5. Damp or Wet Locations: GRC.
  - 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4X stainless steel in damp or wet locations.
- C. EMT conduit may be used as permitted by the NEC, except EMT conduit, couplings, elbows and fittings shall not be installed:

1. In any location outdoors, in direct contact with earth, or underground (in/below slab-on grade or in earth).
  2. Indoors in wet or damp locations, or in concrete, CMU blocks or bricks.
  3. Where exposed to severe corrosive influence and/or severe physical damage.
  4. Encased in concrete, or routed through a concrete floor, slab or deck.
  5. For transition between EMT and rigid conduits (a junction box shall be used).
- D. PVC schedule 40 shall not be used exposed or concealed in gypsum walls, but may be used in CMU walls, in elevated floor slabs and in foundation slabs. Minimum concrete cover shall be 3/4" at finished or formed surface and shall be 3" at concrete surface cast against earth or for slabs placed on-grade, with greater amounts in areas subject to damage or corrosion. Installed systems shall comply with the minimum requirements of ACI318 Chapter 6.
- E. Minimum Raceway Size: 1/2-inch trade size for indoor applications, and 3/4" for exterior branch circuits.
- F. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
  3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- G. Install nonferrous conduit or tubing for circuits operating above 60 Hz.
- H. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- I. Install surface raceways only where indicated on Drawings.
- J. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- F. Install conduit, exposed and concealed (except “in-slab”) parallel to, or at right angles to beams, walls and floors of buildings.
- G. Complete raceway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- J. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- K. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- L. Support conduit within 12 inches of enclosures to which attached.
- M. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 3 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Engineer for each specific location.
- N. Stub-Ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- O. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- P. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- Q. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- R. All conduit shall be provided with insulated throat at terminations.

- S. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- T. EMT terminations shall be made utilizing steel-plated hexagonal compression connectors. EMT couplings shall be of the plated-steel hexagonal compression type. Pot metal, set screw or indented type fittings shall not be allowed.
- U. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- V. Terminate IMC and GRC with either a double locknut/bushing set, or in a threaded hub.
- W. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- X. Where concentric, eccentric or over-sized knockouts are encountered, a grounding-type insulated bushing shall be provided.
- Y. A raceway system shall not be relied upon for grounding continuity. Refer to Section 260526 "Grounding and Bonding" for clarification.
- Z. EMT conduit provided below roof deck shall be installed 1-1/2" away from the deck to allow for screws not to penetrate the EMT conduit during reroofing.
- AA. Conduits, junction boxes, troughs and any enclosure mounted outside of a wall shall be off the wall by one inch.
- BB. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- CC. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- DD. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- EE. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

FF. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Conduit extending from interior to exterior of building.
4. Conduit extending into pressurized duct and equipment.
5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6. Where otherwise required by NFPA 70.

GG. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

HH. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
  - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
  - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
  - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

II. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

- JJ. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- KK. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- LL. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- MM. Locate boxes so that cover or plate will not span different building finishes.
- NN. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- OO. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- PP. Set metal floor boxes level and flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

- 1. Excavate trench bottom to provide firm and uniform support for conduit.
- 2. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction .
- 3. Install manufactured rigid steel conduit elbows for stub-ups at equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
- 4. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

## SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits and fittings, including GRC conduit.
2. Rigid nonmetallic duct.
3. Duct accessories.
4. Polymer concrete handholes and boxes with polymer concrete cover.

#### 1.3 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
  1. Two or more ducts installed in parallel, with or without additional casing materials.
  2. Multiple duct banks.
- D. GRC: Galvanized rigid (steel) conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include duct-bank materials, including spacers and miscellaneous components.
  2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
  3. Include underground-line warning tape.



B. Shop Drawings:

1. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

- a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
- b. Include duct entry provisions, including locations and duct sizes.
- c. Include cover design.
- d. Include grounding details.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

1.6 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electrical service.
  2. Do not proceed with interruption of electrical service without Construction Manager's written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

1.7 UNDERGROUND RACEWAYS

- A. Encased raceways shall be of a type approved by the NEC as "suitable for concrete encasement."
- B. Branch circuit raceways run underground external to building foundation walls shall be run in raceways installed in accordance with the NEC, and shall be of a type approved by the NEC as "suitable for direct burial." Minimum raceway size shall be 1".
- C. Raceways run underground internal to building foundation walls shall be of a type and installed by a method approved by the NEC.
- D. Where passing through a "below grade" wall from a conditioned interior building space, raceways shall be sealed utilizing fittings similar and equivalent to OZ/GEDNEY type "FSK" thru-wall fitting with "FSKA" membrane clamp adapter if required.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.

### 2.2 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC, RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
- C. Solvents and Adhesives: As recommended by conduit manufacturer.

### 2.3 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
- C. A tracer wire shall be installed in-ground above all duct banks.

### 2.4 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- B. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- C. Color: Gray in pavement and sidewalks, green in grass areas.
- D. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- G. Cover Legend: Molded lettering, as indicated for each service.
- H. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- J. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Engineer if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to handholes, and as approved by Engineer.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain. Remove and stockpile topsoil for reapplication.

### 3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC or Type EPC-40-PVC, RNC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Branch Circuits: Type EPC-40-PVC, RNC, direct-buried unless otherwise indicated.
- C. Underground Ducts Crossing Driveways and Roadways: Type EPC-80 PVC RNC, encased in reinforced concrete.

- D. Stub-ups: Concrete-encased GRC.

### 3.3 UNDERGROUND ENCLOSURE APPLICATION

#### A. Handholes and Boxes for 600 V and Less:

1. Units in Roadways and Other Deliberate Traffic Paths: AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Polymer concrete units, SCTE 77, Tier 8 structural load rating.
4. Cover design load shall not exceed the design load of the handhole or box.

### 3.4 EARTHWORK

- A. Excavation and Backfill: Do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and underground structures according to "Cutting and Patching" Article in Section 017300 "Execution."

### 3.5 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, tracer wire and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward handholes and away from buildings and equipment.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.

1. Duct shall have maximum of three 90-degree bends or the total of all bends shall be no more 270 degrees between pull points.
- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. End Bell Entrances to Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.
  1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell, without reducing duct slope and without forming a trap in the line.
  2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch.
  3. Grout end bells into structure walls from both sides to provide watertight entrances.
- G. Terminator Entrances to Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct, and vary proportionately for other duct sizes.
  1. Begin change from regular spacing to terminator spacing 10 feet from the terminator, without reducing duct line slope and without forming a trap in the line.
  2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight-line duct with calculated expansion of more than 3/4 inch.
- H. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- I. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- J. Pulling Cord: Install 200-lbf-test nylon cord in empty ducts.
- K. Concrete-Encased Ducts and Duct Bank:
  1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms for pipes less than 6 inches in nominal diameter.
  2. Width: Excavate trench at least 3 inches wider than duct on each side.
  3. Depth: Install so top of duct envelope is at least 18 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles or for raceways containing circuits with voltages above 600V, unless otherwise indicated.

4. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Minimum Space between Duct: 3 inches between edge of duct and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and communications ducts.
7. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct unless otherwise indicated. Extend encasement throughout length of elbow.
8. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
  - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
  - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches above finished floor and minimum 3 inches from conduit side to edge of slab.
  - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab.
9. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
11. Concrete Cover: For raceways run external to building foundation walls, with the exception of branch circuit raceways, install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.
12. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
  - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.

- b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.
- 13. Pouring Concrete: Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
- L. Direct-Buried Duct and Duct Bank:
  - 1. Excavate trench bottom to provide firm and uniform support for duct.
  - 2. Width: Excavate trench at least 3 inches wider than duct on each side.
  - 3. Depth: Install top of duct at least 36 inches below finished grade unless otherwise indicated.
  - 4. Set elevation of bottom of duct bank below frost line.
  - 5. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  - 6. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
  - 7. Install duct with a minimum of 3 inches between ducts for like services and 6 inches between power and communications duct.
  - 8. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  - 9. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
    - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
      - 1) Stub-ups shall be minimum 4 inches above finished floor and minimum 3 inches from conduit side to edge of slab.
    - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
      - 1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab.

10. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

- a. Place minimum 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.
- b. Place minimum 6 inches of engineered fill above concrete encasement of duct.

M. Underground-Line Warning Tape: Bury nonconducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches above all concrete-encased duct and duct banks and approximately 6 to 8 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

N. Install tracer wires in all ductbanks.

### 3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in asphalt paving and concrete, and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact



with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi, 28-day strength, with a troweled finish.

### 3.7 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
  3. Test handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

### 3.9 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
  1. Sweep floor, removing dirt and debris.
  2. Remove foreign material.

END OF SECTION 260543

## SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Stainless steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.

- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Delegated-Design Submittal: For arc-flash hazard study.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

- E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
  - 1. Color shall be factory applied.
  - 2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Neutral: White.
    - e. Ground: Green.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
  - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
  - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  - 2. Workspace Clearance Warning: For 208Y/120V system – "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

- F. Equipment Identification Labels: Engraved laminated phenolic, with the following material colors:
1. Blue surface with white core for 120/208 volt equipment.
  2. Bright red surface with white core for all equipment related to fire alarm system.
  3. Dark red (burgundy) surface with white core for all equipment related to security.
  4. Green surface with white core for all equipment related to "emergency" systems.
  5. Orange surface with white core for all equipment related to telephone systems.
  6. Brown surface with white core for all equipment related to data systems.
  7. Purple surface with white core for all equipment related to TV systems.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

## 2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

## 2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.



- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
- D. Underground-Line Warning Tape:
  - 1. Tape:
    - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
    - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  - 2. Color and Printing:
    - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
    - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
  - 3. Tag:
    - a. Multilayer laminate, consisting of high-density polyethylene scrim coated with pigmented polyolefin; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
    - b. Width: 6 inches.
    - c. Thickness: 4 mils, minimum.
    - d. Weight: 36.1 lb/1000 sq. ft..
    - e. Tensile according to ASTM D 882: 400 lbf and 11,500 psi.
- E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## 2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened or printed permanent designations; punched for use with self-locking cable tie fastener.
- C. Write-on Tags:
  - 1. Polyester Tags: 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment.

2. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

## 2.7 SIGNS

### A. Baked-Enamel Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 7 by 10 inches.

### B. Metal-Backed Butyrate Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal Size: 10 by 14 inches.

### C. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:
  - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
  - b. For signs larger than 20 sq. in., 1/8 inch thick.
  - c. Engraved legend with black letters on white face.
  - d. Punched or drilled for mechanical fasteners.
  - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 CABLE TIES

### A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

### B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 12,000 psi.

3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

## 2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
  - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- L. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. "EMERGENCY POWER."
  - 2. "POWER."
- M. All outlet boxes, junction boxes and pull boxes shall have their covers and exterior visible surfaces painted with colors to match the surface color scheme outlined below. This includes covers on boxes above lift-out and other type accessible ceilings, where identification shall also include branch circuit designation.
  - 1. Blue surface for 120/208 volt equipment.
  - 2. Bright red surface for all equipment related to fire alarm system.
  - 3. Dark red (burgundy) surface for all equipment related to security.
  - 4. Green surface for all equipment related to "emergency" systems.
  - 5. Orange surface for all equipment related to telephone systems.
  - 6. Brown surface for all equipment related to data systems.
  - 7. Purple surface for all equipment related to TV systems.
- N. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- O. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

Q. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

S. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

T. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Metal Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized plenum-rated cable ties.

X. Nonmetallic Preprinted Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized plenum-rated cable ties.

Y. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using UV-stabilized plenum-rated cable ties.

Z. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

AA. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

BB. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive vinyl label.
  1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
  1. "EMERGENCY POWER."

2. "POWER."

- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- H. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- I. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- J. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- K. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
  - 1. Apply to exterior of door, cover, or other access.
  - 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
    - a. Power-transfer switches.
    - b. Controls with external control power connections.
- N. Arc Flash Warning Labeling: Self-adhesive labels.
- O. Operating Instruction Signs: Self-adhesive labels.

- P. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- Q. Equipment Identification Labels:
1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
  2. Outdoor Equipment: Laminated acrylic or melamine sign.
  3. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of an engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - e. Emergency system boxes and enclosures.
    - f. Enclosed switches.
    - g. Enclosed circuit breakers.
    - h. Enclosed controllers.
    - i. Variable-speed controllers.
    - j. Push-button stations.
    - k. Power-transfer equipment.
    - l. Contactors.
    - m. Remote-controlled switches, dimmer modules, and control devices.
    - n. Power-generating units.
    - o. Monitoring and control equipment.

END OF SECTION 260553





## SECTION 260573.13 - SHORT-CIRCUIT STUDIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

B. Related Requirements:

1. Section 260573.16 "Coordination Studies" for overcurrent protective device coordination studies.
2. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

#### 1.2 DEFINITIONS

- A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- C. SCCR: Short-circuit current rating.
- D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- E. Single-Line Diagram: See "One-Line Diagram."

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies. The Short Circuit Study shall be completed using SKM Power Tools software.

B. Short-Circuit Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form.

- a. Short-circuit study input data, including completed computer program input data sheets.
- b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
- c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

#### 1.5 QUALITY ASSURANCE

- A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms must comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

### PART 2 - PRODUCTS

#### 2.1 POWER SYSTEM ANALYSIS SOFTWARE

- A. Comply with IEEE 399 and IEEE 551.
- B. Analytical features of power systems analysis software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output.
- D. Computer program must be designed to perform short-circuit studies or have function, component, or add-on module designed to perform short-circuit studies.
- E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

#### 2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.

- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kVA and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchboard, panelboard, enclosed breakers, automatic transfer switches, and VFD designations and ratings.
  - 6. Derating factors and environmental conditions.
  - 7. Any revisions to electrical equipment required by study.
- D. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.
- E. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
  - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3. For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
  - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data:
  - 1. One-line diagram of system being studied.
  - 2. Power sources available.
  - 3. Manufacturer, model, and interrupting rating of protective devices.
  - 4. Conductors.
  - 5. Transformer data.
- G. Short-Circuit Study Output Reports:
  - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated fault-current magnitude and angle.
    - c. Fault-point X/R ratio.

- d. Equivalent impedance.
- 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. Calculated asymmetrical fault currents:
    - 1) Based on fault-point X/R ratio.
- 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
  - a. Voltage.
  - b. Calculated symmetrical fault-current magnitude and angle.
  - c. Fault-point X/R ratio.
  - d. No AC Decrement (NACD) ratio.
  - e. Equivalent impedance.
  - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
  - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

### PART 3 - EXECUTION

#### 3.1 POWER SYSTEM DATA

- A. Obtain data necessary for conduct of study.
  - 1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
  - 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
  - 3. For relocated equipment, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers in accordance with NFPA 70E.
- B. Gather and tabulate required input data to support short-circuit study. Record circuit protective device characteristics on Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
  - 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent

- with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at service.
  3. Power sources and ties.
  4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
  8. Motor horsepower and NEMA MG 1 code letter designation.
  9. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
  10. Derating factors.

### 3.2 SHORT-CIRCUIT STUDY

- A. Perform study following general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:
  1. To all normal system low-voltage load buses, even where fault current is 5 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.
  1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.
- I. Include in report identification of protective device applied outside its capacity.

END OF SECTION 260573.13



## SECTION 260573.16 - COORDINATION STUDIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
  - a. Study results must be used to determine coordination of any series-rated devices.

##### B. Related Requirements:

1. Section 260573.13 "Short-Circuit Studies" for fault-current studies.
2. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

#### 1.2 DEFINITIONS

- A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when abnormal current flow exists and then removes the affected portion of the circuit from the system.
- C. SCCR: Short-circuit current rating.
- D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- E. Single-Line Diagram: See "One-Line Diagram."

#### 1.3 ACTION SUBMITTALS

##### A. Product Data:

1. For power system analysis software to be used for studies. The Coordination Study shall be completed using SKM Power Tools software.

##### B. Coordination Study Report:

1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form.



- a. Coordination-study input data, including completed computer program input data sheets.
- b. Study and equipment evaluation reports.
- c. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
- d. Revised one-line diagram, reflecting field investigation results and results of coordination study.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

#### 1.5 QUALITY ASSURANCE

- A. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms must comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

### PART 2 - PRODUCTS

#### 2.1 POWER SYSTEM ANALYSIS SOFTWARE

- A. Comply with IEEE 242 and IEEE 399.
- B. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination at 0.01 seconds, including both Utility and generator by computer-generated, time-current coordination plots.
  1. Optional Features:
    - a. Arcing faults.

- b. Simultaneous faults.
  - c. Explicit negative sequence.
  - d. Mutual coupling in zero sequence.
- D. Computer program must be designed to perform coordination studies or have function, component, or add-on module designed to perform coordination studies.
- E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

## 2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kVA and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchboard, and panelboard designations.
  - 6. Revisions to electrical equipment required by study.
  - 7. Study Input Data: As described in "Power System Data" Article.
    - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
  - 1. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.
    - a. Circuit Breakers:
      - 1) Adjustable pickups and time delays (long time, short time, and ground).
      - 2) Adjustable time-current characteristic.
      - 3) Adjustable instantaneous pickup.
      - 4) Recommendations on improved trip systems, if applicable.
    - b. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists

between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation. Show the following information:

1. Device tag and title, one-line diagram with legend identifying portion of system covered.
2. Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
3. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:
  - a. Power utility's overcurrent protective device.
  - b. Medium-voltage equipment overcurrent relays.
  - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
  - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
  - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
  - f. Cables and conductors damage curves.
  - g. Ground-fault protective devices.
  - h. Motor-starting characteristics and motor damage points.
  - i. Generator short-circuit decrement curve and generator damage point.
  - j. Largest feeder circuit breaker in each motor-control center and panelboard.
5. Maintain selectivity for tripping currents caused by overloads.
6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
7. Provide adequate time margins between device characteristics such that selective operation is achieved.
8. Comments and recommendations for system improvements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
  1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

### 3.2 POWER SYSTEM DATA

- A. Obtain data necessary for conduct of overcurrent protective device study.
1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
  2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
- B. Gather and tabulate required input data to support coordination study. List below is guide. Comply with recommendations in IEEE 551 for amount of detail required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Electrical power utility impedance at service.
  3. Power sources and ties.
  4. Short-circuit current at each system bus (three phase and line to ground).
  5. Full-load current of loads.
  6. Voltage level at each bus.
  7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
  9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
  10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
  12. Maximum demands from service meters.
  13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
  14. Motor horsepower and NEMA MG 1 code letter designation.
  15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
  16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
  17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
    - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

- c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
- d. Generator thermal-damage curve.
- e. Ratings, types, and settings of utility company's overcurrent protective devices.
- f. Special overcurrent protective device settings or types stipulated by utility company.
- g. Time-current-characteristic curves of devices indicated to be coordinated.
- h. Manufacturer, frame size, interrupting rating in amperes root mean square (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. Switchboards and panelboards ampacity, and SCCR in amperes rms symmetrical.
- k. Identify series-rated interrupting devices for condition where available fault current is greater than interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

### 3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at service, extending down to system overcurrent protective devices as follows:
  - 1. To all normal system low-voltage load buses, even where fault current is 5 kA or less.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
  - 1. Device must not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings must protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:

1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's instructions and to IEEE 242.

K. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

L. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.

1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

M. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.
2. Adequacy of switchgear and panelboard bus bars to withstand short-circuit stresses.
3. Application of series-rated devices must be recertified, complying with requirements in NFPA 70.
4. Include in report identification of protective device applied outside its capacity.

### 3.4 FIELD ADJUSTING

- A. Adjust protective device settings according to recommended settings provided by the short circuit and coordination studies; including the use of adjustable trip units for breakers to meet the requirement for selective coordination at 0.01 seconds for both Utility and generator. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting must be by qualified low-voltage electrical testing and inspecting agency.

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for adjustable overcurrent protective devices.

END OF SECTION 260573.16

## SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Related Requirements:

1. Section 260573.13 "Short-Circuit Studies" for fault-current studies.
2. Section 260573.16 "Coordination Studies" for overcurrent protective device coordination studies.

#### 1.2 DEFINITIONS

- A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- C. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.
- D. SCCR: Short-circuit current rating.
- E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- F. Single-Line Diagram: See "One-Line Diagram."

#### 1.3 ACTION SUBMITTALS

A. Product Data:

1. For power system analysis software to be used for studies. The Arc Flash Study shall be completed using SKM Power Tools software.

B. Study Submittals:



1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form:
  - a. Arc-flash study input data, including completed computer program input data sheets.
  - b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
  - c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.
  - d. A digital copy of the project SKM Power Tools file will be reviewed by the Architect.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

#### 1.5 QUALITY ASSURANCE

- A. Study must be performed using SKM Power Tools software.
- B. Software algorithms must comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

### PART 2 - PRODUCTS

#### 2.1 COMPUTER SOFTWARE

- A. Comply with IEEE 1584 and NFPA 70E.
- B. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer program must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.
- D. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

## 2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Conductor types, sizes, and lengths.
  - 3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchboard, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:
  - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
    - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
  - 1. Arcing fault magnitude.
  - 2. Protective device clearing time.
  - 3. Duration of arc.
  - 4. Arc-flash boundary.
  - 5. Restricted approach boundary.
  - 6. Limited approach boundary.
  - 7. Working distance.
  - 8. Hazard risk category.

9. Incident energy in  $\text{cal}/\text{cm}^2$ .
  10. Recommendations for arc-flash energy reduction.
- I. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

## 2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch self-adhesive equipment label for each work location included in analysis.
- B. Where the incident energy is calculated less than  $40 \text{ cal}/\text{cm}^2$ , label must have orange header with wording, "WARNING, ARC-FLASH HAZARD."
- C. Where the incident energy is calculated at or higher than  $40 \text{ cal}/\text{cm}^2$ , label shall have a red header with the wording, "DANGER, ARC-FLASH HAZARD."
- D. Each label must include the following information taken directly from arc-flash hazard analysis:
1. Equipment name.
  2. Location designation.
  3. Nominal system voltage.
  4. Protection boundaries.
    - a. Arc-flash boundary.
    - b. Restricted approach boundary.
    - c. Limited approach boundary.
  5. Arc flash PPE category.
  6. Required minimum arc rating of PPE in  $\text{Cal}/\text{cm}^2$ .
  7. Available incident energy values in  $\text{cal}/\text{cm}^2$ .
  8. Corresponding working distance in accordance with NEC Article 110.16 and NFPA 70E.
  9. Engineering report number, revision number, and issue date.
  10. Informational note stating that label information is only valid for up to 5-years from issue date, and only if significant changes have not been made to the system.
- E. Labels must be machine printed, with no field-applied markings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

### 3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Short-Circuit and Protective Device Coordination studies shall be approved by Engineer prior to starting the Arc-Flash Hazard Analysis.
  - 1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
  - 2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current size.
  - 1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
  - 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current in accordance with IEEE 1584 recommendations.
  - 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
  - 4. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.
- D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations.
- F. Calculate limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:
  - 1. Fault contribution from induction motors must not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).
- H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:
  - 1. When circuit breaker is in separate enclosure.
  - 2. When line terminals of circuit breaker are separate from work location.

- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

### 3.3 POWER SYSTEM DATA

- A. Obtain data necessary for conduct of arc-flash hazard analysis.
  1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
  2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
  3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to amount of detail that is required to be acquired in field. Field data gathering must be under direct supervision and control of engineer in charge of performing study, and must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
  1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Obtain electrical power utility impedance or available short circuit current at service.
  3. Power sources and ties.
  4. Short-circuit current at each system bus (three phase and line to ground).
  5. Full-load current of loads.
  6. Voltage level at each bus.
  7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  8. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
  9. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
  11. Motor horsepower and NEMA MG 1 code letter designation.
  12. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

### 3.4 LABELING

- A. Apply one arc-flash label on front cover of each section of the equipment for each equipment included in study. Base arc-flash label data on highest values calculated at each location.

- B. Each piece of equipment listed below must have arc-flash label applied to it:
  - 1. Switchboards.
  - 2. Distribution panelboards.
  - 3. Branch circuit panelboards.
  - 4. Low voltage transformers.
  - 5. Fused safety switches.
  - 6. Enclosed circuit breakers.
  - 7. Controller and control panels.
- C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.
  - 1. Indicate arc-flash energy.
  - 2. Indicate protection level required.

### 3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573.19



## SECTION 260800 - ELECTRICAL COMMISSIONING REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this section.

#### 1.2 SUMMARY

- A. Section includes commissioning process requirements Mechanical systems assemblies and equipment.
- B. Related Sections
  - 1. Section 011000 – Summary of Work
  - 2. Section 013100 – Project Management and Coordination
  - 3. Section 013300 – Submittal Procedures
  - 4. Section 017700 – Closeout Procedures
  - 5. Section 017823 – Operation and Maintenance Data
  - 6. Section 017839 – Project Record Documents
  - 7. Section 017900 – Demonstration and Training
  - 8. Section 019113 – General Commissioning Requirements
  - 9. Section 230800 –Commissioning of HVAC

#### 1.3 DESCRIPTION

- A. Commissioning
  - 1. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the owner's project requirements and operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives:
  - 2. Verify that applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
  - 3. Verify and document proper functional performance of equipment and systems.
  - 4. Verify that O&M documentation left on site is complete.
  - 5. Verify that the Owner's operating personnel are adequately trained.
- B. Abbreviations



1. The following are common abbreviations used in the Specifications:

A/E	Architect and Design Engineers
CxA	Commissioning Authority
CC	Controls Contractor
CM	Construction Manager (the Owner's Representative)
Cx	Commissioning
Cx Plan	Commissioning Plan Document
EC	Electrical Contractor
FT	Functional Performance Test
GC	General Contractor
MC	Mechanical Contractor
PC	Prefunctional Checklist
OPM	Project Manager (of the Owner)
Subs	Subcontractors to General
TAB	Test and Balance Contractor

#### 1.4 ELECTRICAL EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

- A. The following electrical equipment and systems shall be commissioned in this project:

1. Electrical Systems
  - a. Observe contractor start-up procedures and load bank testing of generator.
  - b. Conduct a field blackout test. Verify emergency lighting, elevator emergency operation, ATS sequence, generator start time.
  - c. Verify breaker and GFCI settings with protective device coordination report.
  - d. Review installation of main distribution equipment, transformers and panels 600 amps and larger.
  - e. Building lighting and lighting control - Verify luminaires for proper operation.
  - f. Fire Alarm system verification, if applicable, verify interlocks with mechanical system (no NFPA 72 requirements).

#### 1.5 SUBMITTALS

- A. Provide the CxA a copy of the following items, for the systems to be commissioned:

1. Equipment and System Submittals to include, at minimum, the following:
  - a. Cut Sheets
  - b. Performance data
2. Manufacturer's pre-startup checklists
  - a. Manufacturer's start-up checklists
3. Installation Instructions

4. Shop drawings (including any resubmittals required by the A/E)
5. Short-circuit analysis and coordination study
6. Protective device settings
7. Testing plan
8. Completed field test report, including all completed forms and checklist; and list of all outstanding deficiencies and uncompleted items
9. Operational and maintenance documentation
10. Training plan and training materials
11. As-built documentation

## PART 2 - PRODUCTS

### 2.1 TEST EQUIPMENT

- A. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Infrared scanning equipment shall be an FLIR (or approved equal) thermal imaging camera set capable of viewing an entire bus or equipment assembly at one time. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified.

## PART 3 - EXECUTION

### 3.1 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

- A. The following procedures apply to all equipment to be commissioned, according to Section 1.4 above.
- B. General
  1. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system. A sample prefunctional checklist is provided in Attachment 'A', Specification Section 23 08 00.
  2. Independent Testing Agencies: For systems where independent testing agencies (TC) are specified, the cost of this testing is borne by the contractor. Much of the testing performed by these independent agencies will cover aspects required in the commissioning start ups and functional performance tests requirements. Contractor and testing agencies shall coordinate with the CxA so that they can witness the testing and approve the applicable aspects of the FPTs. CxA may in some cases independently spot check work of the testing agencies if the tests were not witnessed. However it is not the intent for the TC to re-accomplish testing that is specified in the construction specifications. For instance much of the testing requirements for the Electrical Testing will be performed by the independent

electrical testing agency provided with under the contract. CxA will witness the indicated sample of the TC testing and record the results in the record of functional performance testing.

C. Start-up and Initial Checkout Plan

1. The CxA will review manufacturer's pre-functional checklists and start-up procedures.
2. The subcontractor responsible for providing and installing the equipment develops the full start-up plan by combining (or adding to) NETA-ATS with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspection of each procedure and a summary statement with a signature block at the end of the plan.
3. The full start-up plan shall consist of:
  - a. The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end
  - b. NETA Testing Procedure Checklists.
  - c. The manufacturer's normally used field checkout sheets
4. The contractor submits the full startup plan to the CxA for review and approval.
5. The CxA reviews and approves the procedures and the format for documenting them, noting any plans that need to be added.

D. Execution of Prefunctional Checklists and Startup

1. Two weeks prior to startup, the Subs and vendors shall schedule startup and checkout with the OPM, CM and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.
2. The CxA and possibly the A/E will observe the procedures and tests for selected pieces of primary equipment. It is the intent the CxA will observe the tests during contractor testing. If the contractor does not inform the CxA of testing, the CxA may request the contractor to repeat the test.
3. The CxA will observe the physical start-up of all major systems.
4. The Subs and vendors shall execute startup and provide the CM with a signed and dated copy of the completed start-up and prefunctional tests and checklists. The CM reviews for completion and accuracy, then submits to the CxA and A/E.
5. Only individuals that have direct knowledge and witnessed that a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.
6. Completed startup testing report must be provided to CxA prior to functional testing.

E. Deficiencies, Non-Conformance and Approval in Checklists and Startup

1. The Sub(s) shall clearly list any outstanding items of the initial start-up and prefunctional procedures that were not completed successfully. The procedures form and any outstanding deficiencies shall be provided to the CxA within two days of test completion.
2. The CxA will work with the Sub(s) and vendors to determine what is required to correct outstanding deficiencies and retest deficiencies of uncompleted items. The CxA will involve the PM and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected.
3. Items left incomplete, which later cause deficiencies or delays during functional testing may result in backcharges to the responsible party. Refer to Section 01 91 13, 3.6 – Documentation, Non-Conformance and Approval of Tests.

### 3.2 FUNCTIONAL PERFORMANCE TESTING

- A. This sub-section applies to functional testing for equipment and system in this division.
- B. The general list of equipment and systems to be commissioned is found in Paragraph 1.4.
- C. Objectives and Scope
  1. The objective of functional performance testing is to demonstrate that each system is operating according to the owner's project requirements, documented project program, and Contract Documents. Functional testing facilitates bringing the systems from a state of Project Acceptance to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and function of the systems.
  2. In general, each system shall be operated through all modes of operation (seasonal, occupied, unoccupied, failures, interlocks, warm-up, safety, etc.) where there is a specified system response. Verifying each sequence in the sequences of operation is required.
  3. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.
  4. The contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, tools, instruments, ladders, lifts, computers, software, cables, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific systems, and automation hardware and software. All training documentation, O&Ms, and submittals shall be at the job site before functional testing commences.
- D. Development of Test Procedures
  1. Electrical testing procedures shall be based on NETA-ATS or manufacturer's testing procedures (central inverter). The A/E and Sub(s) shall point out to the CxA any specific problems as related to feasibility, safety, equipment and warranty protection. CxA will observe testing by manufacturers or installing contractors and obtain test reports for inclusion into the Commissioning Final Report.
- E. Coordination and Scheduling

1. The CM shall provide sufficient notice to the CxA regarding the Subs completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests after written notification from the CM and affected Subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.
2. In general, functional testing shall not be scheduled until all hardware and software submittals are approved, Prefunctional checklists are approved, and start-up has been satisfactorily completed. Scheduling of functional testing shall be done with a minimum of two weeks' notice prior to testing. Functional testing of the equipment and systems listed in section 1.4 of this specification section shall not be conducted out of the presence of the CxA and OPM, unless specifically approved to do so in writing by the CxA or OPM. Any functional testing which occurs outside the presence of the CxA or OPM without written authorization to do so will be required to be re-tested at no expense to the owner.

F. Demonstration, Verification and Validation

1. The electrical systems demonstration shall include, at minimum, the following:
  - a. Normal Power Switchboard and distribution panels 600A and above
  - b. Emergency Generator
  - c. Transfer switches
  - d. Breaker and GFCI settings according to protective device coordination report.
  - e. Fire Alarm System interlocks with Mechanical Systems (in conjunction with Authority Having Jurisdiction inspection)
  - f. Building lighting and lighting control
    - 1) 10% Occupancy sensors
    - 2) 25% Exterior Lighting Controls
  - g. Demonstrate that all functions of the lighting and daylighting control systems meet the specified requirements. A maximum of 25% of devices will be validated by the CxA.

G. Problem Solving

1. The CxA will recommend solutions to problems found; however, the burden of responsibility to solve, correct, and retest problems is with the CM, Subs and A/E.

3.3 OPERATION AND MAINTENANCE MANUALS

- A. In addition to installation manuals, the contractor shall provide one copy of the Operation and Maintenance Manuals to the CxA for the systems to be commissioned. The O&M Manuals shall be provided to the CxA at least 8 weeks prior to the start of Functional Testing.

END OF SECTION 260800

## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Indoor vacancy sensors.
  - 2. Emergency shunt relays.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Show installation details for the following:
    - a. Vacancy sensors.
  - 2. Interconnection diagrams showing field-installed wiring.
  - 3. Include diagrams for power, signal, and control wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which equipment will be attached.
  - 3. Items penetrating finished ceiling, including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.

- f. Control modules.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of lighting control software.
    - b. Faulty operation of lighting control devices.
  - 2. Warranty Period: Two year(s) from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 INDOOR VACANCY SENSORS

- A. General Requirements for Sensors:
  - 1. Wall and ceiling-mounted, solid-state, indoor vacancy sensors.
  - 2. Dual technology.
  - 3. Separate power pack.
  - 4. Hardwired connection to switch.
  - 5. Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
  - 6. Operation:
    - a. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
  8. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  9. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  10. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  11. Bypass Switch: Override the "on" function in case of sensor failure.
- B. Dual-Technology Type: Wall and ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and 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.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.

## 2.2 SWITCHBOX-MOUNTED VACANCY SENSORS

- A. General Requirements for Sensors: Automatic-wall-switch vacancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, with provisions for connection to BAS using hardwired connection.
1. Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
  2. Vacancy Sensor Operation: Unless otherwise indicated, manually turn lights on; turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
  4. Switch Rating: Not less than 1200-VA LED load at 120 V.



### 2.3 EMERGENCY SHUNT RELAY

- A. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 1008.
  - 1. Coil Rating: 120V.

### 2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90-percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

### 3.3 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.
- C. Identify each switch with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections according to Section 260800 "Electrical Commissioning Requirements."
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.

### 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Final Acceptance, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

### 3.7 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Final Acceptance, service agreement shall include software support for two years.
- B. Upgrade Service: At Final Acceptance, update software to latest version. Install and program software upgrades that become available within two years from date of Final Acceptance. Upgrading software shall include operating system and new or revised licenses for using software.
  1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### 3.8 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems.
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

## SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 500 kVA.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
  - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
  - 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each transformer type from single source from single manufacturer.

### 2.2 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with NFPA 70.
  - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
  - 1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
  - 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

### 2.3 DISTRIBUTION TRANSFORMERS

- A. Comply with NFPA 70, and list and label as complying with UL 1561.
- B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
  - 1. One leg per phase.
  - 2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
  - 3. Grounded to enclosure.

- C. Coils: Continuous windings except for taps.
  - 1. Coil Material: Copper.
  - 2. Internal Coil Connections: Brazed or pressure type.
  - 3. Terminal Connections: Welded.
- D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- E. Enclosure: Ventilated.
  - 1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
  - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
  - 3. Wiring Compartment: Sized for conduit entry and wiring installation.
  - 4. Finish: Comply with NEMA 250.
    - a. Finish Color: Gray weather-resistant enamel.
- F. Taps for Transformers 3 kVA and Smaller: None.
- G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.
- I. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 80deg C rise above 40 deg C ambient temperature.
- K. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.
- L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
  - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
  - 2. Include special terminal for grounding the shield.
- M. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91.

## 2.4 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

## 2.5 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
  - 1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
  - 2. Ratio tests at rated voltage connections and at all tap connections.
  - 3. Phase relation and polarity tests at rated voltage connections.
  - 4. No load losses, and excitation current and rated voltage at rated voltage connections.
  - 5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
  - 6. Applied and induced tensile tests.
  - 7. Regulation and efficiency at rated load and voltage.
  - 8. Insulation-Resistance Tests:
    - a. High-voltage to ground.
    - b. Low-voltage to ground.
    - c. High-voltage to low-voltage.
  - 9. Temperature tests.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

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

### 3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
  - 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
  - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions. Furnish and install additional vibration isolation pads at the transformer footing if part of the manufacturer installation guidance.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

### 3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- 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-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.



### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Dry-Type Transformer Field Tests:
  - 1. Visual and Mechanical Inspection.
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, and grounding.
    - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
    - d. Verify the unit is clean.
    - e. Perform specific inspections and mechanical tests recommended by manufacturer.
    - f. Verify that as-left tap connections are as specified.
    - g. Verify the presence of surge arresters and that their ratings are as specified.
  - 2. Electrical Tests:
    - a. Measure resistance at each winding, tap, and bolted connection.
    - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
    - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
    - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- E. Remove and replace units that do not pass tests or inspections and retest as specified above.
- F. Infrared Scanning: Perform an infrared scan of transformer connections.
  - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
  - 2. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213



## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Panelboards shall not be released until final approval of the following associated submittals:
  - 1. 260573.13 "Short-Circuit Studies."
  - 2. 260573.16 "Coordination Studies."
  - 3. 260573.19 "Arc-Flash Hazard Analysis."

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. MCCB: Molded-case circuit breaker.
- E. NEC: National Electrical Code.
- F. VPR: Voltage protection rating.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
  - 1. Include materials, switching and overcurrent protective devices, accessories, and components indicated.
  - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices based on Short Circuit Study.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing as required by the NEC.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Do not proceed with interruption of electric service without Construction Manager's written permission.
  - 3. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
  - 1. Panelboard Warranty Period: 18 months from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 PANELBOARDS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems".
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.
- F. Feed-through panels and load centers are not permitted.
- G. Maximum number of circuit breakers in a panelboard shall not exceed 42 poles.
- H. Enclosures: Surface-mounted, dead-front cabinets.
  - 1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 4X.
    - c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4X.
    - d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  - 2. Height: 84 inches maximum.
  - 3. Front: Enclosure door shall be furnished with continuous hinge door-in-door type construction.
  - 4. Finishes:
    - a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - b. Back Boxes: Galvanized steel.
    - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
- I. Incoming Mains:

1. Location: Convertible between top and bottom.
  2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.
- J. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
    - a. Plating shall run entire length of bus.
    - b. Bus shall be fully rated the entire length.
  2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
  3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  4. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
- K. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Terminations shall allow use of 75 deg C rated conductors without derating.
  3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
  4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
  5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
- L. NRTL Label: Panelboards shall be labeled by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- M. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- N. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals based on Short Circuit Study. Assembly listed by an NRTL for 100 percent interrupting capacity. The use of series rated circuit breakers is not acceptable.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
  2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.



- O. All circuit breakers capable of having a trip rating of 1200A and larger shall have an integral arc flash reduction maintenance switch to reduce incident energy.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

## 2.3 POWER PANELBOARDS

- A. Panelboards: NEMA PB 1, distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- C. Mains: Circuit breaker or lugs only per Drawings.
- D. Panelboards rated 600A and less shall utilize bolt-on circuit breakers.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker or lugs only per Drawings.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Provide energy-reducing maintenance switching with local status indicator for all breakers capable of having 1200A or higher trip rating to comply with NEC Article 240.87.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents per Short Circuit Study.
  - 1. Thermal-Magnetic Circuit Breakers:
    - a. Inverse time-current element for low-level overloads.
    - b. Instantaneous magnetic trip element for short circuits.

- c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- 3. Electronic Trip Circuit Breakers:
  - a. RMS sensing.
  - b. Field-replaceable rating plug or electronic trip.
  - c. Digital display of settings, trip targets, and indicated metering displays.
  - d. Multi-button keypad to access programmable functions and monitored data.
  - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
  - f. Integral test jack for connection to portable test set or laptop computer.
  - g. Field-Adjustable Settings:
    - 1) Instantaneous trip.
    - 2) Long- and short-time pickup levels.
    - 3) Long and short time adjustments.
    - 4) Ground-fault pickup level, time delay, and I squared T response where applicable.
- 4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
- 5. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 6. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
- 7. Subfeed Circuit Breakers: Vertically mounted.
- 8. MCCB Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Breaker handle indicates tripped status.
  - c. UL listed for reverse connection without restrictive line or load ratings.
  - d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  - e. Application Listing: Appropriate for application.
  - f. Ground-Fault Protection: Where required, integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

## 2.6 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.
- B. Equipment labeling for the flash protection boundary and the incident energy shall be determined in accordance with IEEE 1584, NFPA 70E and NEC 110-16 requirements.

- C. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- D. Circuit Directory: Computer-generated typed circuit directory mounted inside panelboard door with transparent plastic protective cover.
  - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

## 2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.
- B. Receive, inspect, handle, and store panelboards according to NECA 407.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NECA 407.
- D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
  2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- G. Mount panelboard cabinet plumb and rigid without distortion of box.
- H. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- I. Install overcurrent protective devices and controllers not already factory installed.
1. Set field-adjustable, circuit-breaker trip ranges.
  2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- J. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- K. Install filler plates in unused spaces.
- L. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.
- M. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- N. Branch circuits shall have individual neutrals; no sharing of the neutral between circuits is allowed.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.
- F. The number of the branch circuit shall be identified with a permanent wire tag attached to the wire.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each 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 for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 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, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

- C. Load Balancing: After Project Acceptance, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Engineer of effect on phase color coding.
  - 1. Measure loads during period of normal facility operations.
  - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Engineer. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
  - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

### 3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416



## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Standard-grade receptacles, 125 V, 20 A.
  - 2. GFCI receptacles, 125 V, 20 A.
  - 3. Cord and plug sets.
  - 4. Toggle switches, 120/277 V, 20 A.
  - 5. Wall-box dimmers.
  - 6. Wall plates.
  - 7. Floor service fittings.
  - 8. Poke-through assemblies.

#### 1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.



## PART 2 - PRODUCTS

### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices for Owner-Furnished Equipment:
  - 1. Receptacles: Match plug configurations.
  - 2. Cord and Plug Sets: Match equipment requirements.
- F. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
- G. Wall Plate Color: For plastic covers, match device color.
- H. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

### 2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
  - 1. Description: Two pole, three wire, and with grounding screw.
  - 2. Configuration: NEMA WD 6, Configuration 5-20R.
  - 3. Standards: Comply with UL 498 and FS W-C-596.
- B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
  - 1. Description: Two pole, three wire, and with grounding screw. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
  - 2. Configuration: NEMA WD 6, Configuration 5-20R.
  - 3. Standards: Comply with UL 498 and FS W-C-596.
  - 4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and with grounding screw.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Non-feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.4 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

D. Four-Way Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

E. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A:

1. Description: Illuminated when switch is on.
2. Standards: Comply with UL 20 and FS W-S-896.

F. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:

1. Description: For use with mechanically held lighting contactors.
2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

## 2.6 VACANCY SENSORS

### A. Wall Switch Sensor Light Switch, Dual Technology:

1. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
2. Standards: Comply with UL 20.
3. Rated 10 A at 120 V ac or 10 A at 277 V ac for LED lighting, and 1/4 hp at 120 V ac.
4. Adjustable time delay of 30 minutes.

## 2.7 DIMMERS

### A. Wall-Box Dimmers:

1. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
2. Control: Continuously adjustable slider; with single-pole or three-way switching.
3. Standards: Comply with UL 1472.
4. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.8 WALL PLATES

### A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

### B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

### C. Wet-Location, Weatherproof while-in-use Cover Plates: NEMA 250, complying with Type 3R, weather-resistant extra duty with lockable cover.

## 2.9 FLOOR SERVICE FITTINGS

### A. Flush-Type Floor Service Fittings:

1. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
2. Compartments: Barrier separates power from voice and data communication cabling.
3. Service Plate and Cover: Rectangular, with satin finish.

4. Power Receptacles: Two NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
5. Data Communication Outlet: Four modular, keyed, color-coded, RJ-45 jacks for twisted pair cable.

## 2.10 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Standards: Comply with scrub water exclusion requirements in UL 514.
- C. Service-Outlet Assembly: Flush type with two duplex receptacles and space for four RJ-45 jacks.
- D. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
- E. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
- F. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
- G. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle and light switch with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.4 FIELD QUALITY CONTROL

- A. Test Instruments: Use instruments that comply with UL 1436.
- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Tests for Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.
- E. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION 262726



## SECTION 262813 - FUSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:
  - a. Control circuits.
  - b. Enclosed controllers.
  - c. Enclosed switches.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  1. Ambient temperature adjustment information.
  2. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project.
  3. Coordination charts and tables and related data.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

#### 2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.



1. Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  2. Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
  3. Type CC: 600-V, zero- to 30-A rating, 200 kAIC, fast acting.
  4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, fast acting.
  5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
1. Feeders: Class J, time delay.
  2. Motor Branch Circuits: Class RK1 or Class RK5, time delay.
  3. Other Branch Circuits: Class J, time delay.
  4. Control Transformer Circuits: Class CC, time delay, control transformer duty.
  5. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813



## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Shunt trip switches.
  - 4. Molded-case circuit breakers (MCCBs).
  - 5. Enclosures.

#### 1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
  - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment qualified testing agency.
- B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
    - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  2. Altitude: Not exceeding 6600 feet.

## 1.8 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Project Acceptance.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

### 2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

### 2.3 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

- B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
3. Lugs: Mechanical type, suitable for number, size, and conductor material.

## 2.4 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
  - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
  - 2. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 4. Service-Rated Switches: Labeled for use as service equipment.

## 2.5 SHUNT TRIP SWITCHES

- A. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Nonfusible Switch: 600-V ac, UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac.
- E. Accessories:
  - 1. Oiltight green ON pilot light.
  - 2. Isolated neutral lug; 100 percent rating.
  - 3. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
  - 4. Form C alarm contacts that change state when switch is tripped.
  - 5. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
  - 6. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contacts, arranged to activate before switch blades open. Contact rating - 120-V ac.
  - 7. Lugs: Mechanical type, suitable for number, size, and conductor material.
  - 8. Service-Rated Switches: Labeled for use as service equipment.

## 2.6 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker.
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- F. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- G. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- H. 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.
- I. 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.

## 2.7 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) for interior locations; exterior locations shall be NEMA Type 4X.
- C. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock



mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

#### 3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  - 1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
  - 2. Indicate method of providing temporary electric service.
  - 3. Do not proceed with interruption of electric service without Construction Manager's written permission.
  - 4. Comply with NFPA 70E.

#### 3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
  - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
  - 2. Outdoor Locations: NEMA 250, Type 4X.
  - 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4X.
  - 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

### 3.4 INSTALLATION

- 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.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NFPA 70 and NECA 1.

### 3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment to perform tests and inspections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative.
- C. Tests and Inspections for Switches:
  - 1. Visual and Mechanical Inspection:
    - a. Inspect physical and mechanical condition.
    - b. Inspect anchorage, alignment, grounding, and clearances.
    - c. Verify that the unit is clean.
    - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - e. Verify that fuse sizes and types match the Specifications and Drawings.
    - f. Verify that each fuse has adequate mechanical support and contact integrity.
    - g. Inspect bolted electrical connections:

- 1) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
  - i. Verify correct phase barrier installation.
  - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:
  - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
  - b. Inspect physical and mechanical condition.
  - c. Inspect anchorage, alignment, grounding, and clearances.
  - d. Verify that the unit is clean.
  - e. Operate the circuit breaker to ensure smooth operation.
  - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter.

- a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
  - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
    - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
  - h. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
  - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
  - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
  - e. Determine the following by primary current injection:
    - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
    - 3) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

- f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
  - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
  - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
  - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
- 3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- 4. 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.
  - 1. Test procedures used.
  - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
  - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

### 3.7 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 the Coordination Study.

END OF SECTION 262816

## SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. DDC: Direct digital control.
- C. EMI: Electromagnetic interference.
- D. LED: Light-emitting diode.
- E. NC: Normally closed.
- F. NO: Normally open.
- G. OCPD: Overcurrent protective device.
- H. PID: Control action, proportional plus integral plus derivative.
- I. RFI: Radio-frequency interference.
- J. VFC: Variable-frequency motor controller.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
  - 1. Include dimensions and finishes for VFCs.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting 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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Data: Certificates, for each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

C. Product Certificates: For each VFC from manufacturer.

D. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519. The IEEE 519 Harmonic Analysis shall be based on the following information which will be provided by the Contractor and Architect/Engineer during construction based on actual equipment being provided:

1. Electric utility available short circuit current, transformer size and type, X/R ratio.
2. Service conductor size and length.
3. Electrical distribution system primary and secondary points of common coupling where the analysis is to be conducted.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

- a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
  - b. Manufacturer's written instructions for setting field-adjustable overload relays.
  - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
  - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
  - e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
  - f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.
2. Provide a written copy of the VFC manufacturer standard parameter record summary sheet with actual configured values of all parameters entered as part of equipment startup and commissioning.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  3. Indicating Lights: Two of each type and color installed.
  4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
  5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.



## 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Danfoss Inc.
  - 2. Eaton.
  - 3. Rockwell Automation, Inc.
  - 4. Schneider Electric USA, Inc.
  - 5. Siemens Industry, Inc., Building Technologies Division.

### 2.2 SYSTEM DESCRIPTION

- A. General Requirements for VFCs:
  - 1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to label electrical and mechanical equipment, and marked for intended location and application.
  - 2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.
- B. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
  - 1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
  - 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
  - 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

- C. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- D. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- E. Unit Operating Requirements:
  - 1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
  - 2. Input AC Voltage Unbalance: Not exceeding 5 percent.
  - 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
  - 4. Minimum Efficiency: 97 percent at 60 Hz, full load.
  - 5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
  - 6. Minimum Short-Circuit Current (Withstand) Rating: 22 kA.
  - 7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
  - 8. Humidity Rating: Less than 95 percent (noncondensing).
  - 9. Altitude Rating: Not exceeding 3300 feet.
  - 10. Vibration Withstand: Comply with NEMA ICS 61800-2.
  - 11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
  - 12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
  - 13. Speed Regulation: Plus or minus 5 percent.
  - 14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
  - 15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- F. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- G. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
  - 1. Signal: Electrical.
- H. Internal Adjustability Capabilities:
  - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
  - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
  - 3. Acceleration: 0.1 to 999.9 seconds.
  - 4. Deceleration: 0.1 to 999.9 seconds.
  - 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- I. Self-Protection and Reliability Features:
  - 1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
  - 2. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
  - 3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.

4. Under- and overvoltage trips.
  5. Inverter overcurrent trips.
  6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
  7. Critical frequency rejection, with three selectable, adjustable deadbands.
  8. Instantaneous line-to-line and line-to-ground overcurrent trips.
  9. Loss-of-phase protection.
  10. Reverse-phase protection.
  11. Short-circuit protection.
  12. Motor-temperature fault.
- J. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- K. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- L. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- M. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- N. Integral Input Disconnecting Means and OCPD: UL 489, molded-case switch, with power fuse block and current-limiting fuses with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.

## 2.3 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
  2. Run.
  3. Overvoltage.
  4. Line fault.
  5. Overcurrent.
  6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
  2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
    - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
  2. Running log of total power versus time.
  3. Total run time.
  4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
  2. Motor speed (rpm).
  3. Motor status (running, stop, fault).
  4. Motor current (amperes).
  5. Motor torque (percent).
  6. Fault or alarming status (code).
  7. PID feedback signal (percent).
  8. DC-link voltage (V dc).
  9. Set point frequency (Hz).
  10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
    - a. A minimum of six multifunction programmable digital inputs.
  2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
    - a. 0- to 10-V dc.
    - b. 4- to 20-mA dc.
    - c. Potentiometer using up/down digital inputs.
    - d. Fixed frequencies using digital inputs.
  3. Output Signal Interface: A minimum of one programmable analog output signal(s) ( 4- to 20-mA dc), which can be configured for any of the following:
    - a. Output frequency (Hz).

- b. Output current (load).
  - c. DC-link voltage (V dc).
  - d. Motor torque (percent).
  - e. Motor speed (rpm).
  - f. Set point frequency (Hz).
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
  - 1. Number of Loops: One.
- G. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
  - 1. Hardwired Points:
    - a. Monitoring: On-off status.
    - b. Control: On-off operation.
  - 2. DDC control points shall be directly communicated to the BAS from the VFC without the need for gateway or BAS overlay control devices for the following:
    - a. VFC amps.
    - b. VFC temperature.
    - c. VFC kWh usage with reset.
    - d. VFC operating hour with reset.
    - e. Percent power usage.
    - f. Fault Monitoring (type of fault) with remote reset capability.
  - 3. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor VFC from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at VFC shall be available through the DDC system for HVAC.

## 2.4 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations. The point of common coupling will be provided as the basis for the IEEE 519 Harmonic Analysis by the Architect / Engineer during construction.
- B. Output Filtering: Provide filtering to limit current harmonic distortion to no more than 3% per harmonic.
- C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

- D. EMI/RFI Filtering: < 5 percent current THD.

## 2.5 BYPASS SYSTEMS

- A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Manual operation only; requires local operator selection at VFC. Transfer between power converter and bypass contactor, and retransfer shall only be allowed with the motor at zero speed.
- C. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
1. Bypass Contactor: Load-break, NEMA-rated contactor.
  2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
  3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- D. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
1. Bypass Contactor: Load-break, NEMA-rated contactor.
  2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
  3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.
- E. Bypass Contactor Configuration: Full-voltage (across-the-line) type.
1. NORMAL/BYPASS selector switch.
  2. HAND/OFF/AUTO selector switch.
  3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
  4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.
    - a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

- b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
- 5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
  - a. CPT Spare Capacity: 100 VA.
- 6. Overload Relays: NEMA ICS 2.
  - a. Solid-State Overload Relays:
    - 1) Switch or dial selectable for motor-running overload protection.
    - 2) Sensors in each phase.
    - 3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
    - 4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
    - 5) Analog communication module.

## 2.6 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
  - 1. Dry and Clean Indoor Locations: Type 1.
  - 2. Outdoor Locations: Type 4X.
  - 3. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

## 2.7 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
  - 1. Push Buttons: Covered.
  - 2. Pilot Lights: Push to test.
  - 3. Selector Switches: Rotary type.
  - 4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- B. Reversible NC/NO bypass contactor auxiliary contact(s).

- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
  - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- E. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- F. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Cooling Fan and Exhaust System: For NEMA 250, Type 12; UL 508 component recognized: Supply fan, with stainless-steel intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.
- H. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- I. Spare control-wiring terminal blocks; wired.

## 2.8 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
  - 1. Test each VFC while connected to its specified motor.
  - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.



- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
  - 1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
  - 2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."
- D. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- F. Install fuses in each fusible-switch VFC.
- G. Install fuses in control circuits if not factory installed.

- H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- J. Comply with NECA 1.

### 3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control devices where applicable.
  - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
  - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

### 3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
  - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  - 2. Label each VFC with engraved nameplate.
  - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
9. Field test each VFC in accordance with IEEE 519 requirements to verify output filtering, EMI/RFI filtering provided for each VFC have limited harmonic distortion to the requirements specified in IEEE 519 and Section 2.4 of this specification.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

### 3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

### 3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Final Acceptance.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable pressure switches.

### 3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Final Acceptance.

### 3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 262923



SECTION 263100 - PHOTOVOLTAIC COLLECTORS (ADD ALTERNATE NO. 1, NO. 2 & NO. 2A)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF CIVIL ENGINEERS

ASCE -7 Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL

ASTM D 709 Laminated Thermosetting Materials

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61215 Crystalline Silicone Terrestrial Photovoltaic (PV) Modules Design  
Qualification and Type Approval

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 1547 Interconnecting Distributed Resources with Electric Power Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 National Electrical Code - 2020 Edition with North Carolina  
amendments

UNDERWRITERS LABORATORIES (UL)

UL 1703/UL 61730 Safety for Flat-Plate Photovoltaic Modules and Panels

UL 1741 Standard for Static Inverters and Charge Controllers for Use in  
Photovoltaic Systems

1.3 SUMMARY

- A. These specifications cover the procurement of equipment, hardware, documentation, labor and supervision required for the design and installation of a 77.6 kW-DC grid-connected Photovoltaic (PV) system. There shall be no energy storage devices (e.g. batteries) used in this system. (See Alternate #2)

- B. The PV system shall be designed for outdoor roof installation at the Maritime Education Center - Beaufort, North Carolina. Ambient temperatures can range from Minus 26° F to +90° F. The basic wind speed is 144 mph (ASCE 7-10). Supplied equipment must be rated and warranted to withstand and operate under these conditions.
- C. The array shall be roof-mounted with non-penetrating clips attached to the roof supporting structure in a manner that is in accordance with the roofing manufacturer's recommendations and acceptable to the Owner. The PV supporting frame and building roof will have a horizontal tilt angle as shown on the Drawings.
- D. The PV system shall be connected to the building service through a grid-interactive power conversion system (inverter). The design and specification of the PV modules, power conditioners, utility interconnections, PV system electrical design, and PV array mechanical design shall meet the requirements of the National Electrical Code and comply with the requirements of the local utility company.
- E. The PV system shall consist of the arrays, pass through boxes, fused DC disconnects, inverters, AC fused disconnects, Utility required disconnect, arc fault protection, rapid shutdown function, and point of connection.
- F. Contractor shall be aware of all the documentation and procedural issues required and shall have been trained and experienced in installing grid-connected photovoltaic systems.
- G. The PV system shall not be connected without the permission of the Utility Company. The Contractor shall coordinate with the local Utility Company and assist the Owner by preparing and submitting an Interconnection Application and obtaining a new or amending an existing "Interconnection Agreement" in accordance with the serving Utility Company.
- H. Contractor shall apply for and set up all third parties monitoring for rebates and incentive recovery. Owner shall be listed as recipient of rebate incentive.
- I. PV system is delegated design and must be signed by a licensed PE in the State of NC.

#### 1.4 DEFINITIONS

- A. Array: A mechanically integrated assembly of modules or panels with a support structure or foundation to form a direct current power producing unit.
- B. Inverter: Equipment that is used to change voltage level or waveform or both, of electrical energy and is used to change Direct Current (DC) to Alternating Current (AC).
- C. Module: A complete, environmentally protected unit consisting of solar cells and other components designed to generate DC current when exposed to sunlight.
- D. MPPT: Maximum power point tracking.
- E. NABCEP: North American Board of Certified Energy Practitioners.

- F. NEC: National Electrical Code.
- G. Panel: A collection of modules mechanically fastened together, wired, and designed to provide a field-installable unit.
- H. PTC: USA standard conditions for PV.
- I. PV: Photovoltaic.
- J. STC: Standard Test Conditions defined in IEC 61215.
- K. String: A group of modules wired together to form a single circuit and provide a source circuit.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for PV panels.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly.
  - 4. Include diagrams for power, signal, and control wiring.
  - 5. Electrical shop drawings of the PV system signed and sealed by a North Carolina professional electrical engineer.
  - 6. Attachment of PV support system to standing metal seam roof shall be with non-penetrating clip mounting system.
  - 7. Structural shop drawings of the PV support system signed and sealed by a North Carolina professional structural engineer. Structural loading criteria is as indicated on structural drawings and mentioned herein.
  - 8. Structural loading criteria: Operating weight of solar panel system (panels and mounting racks) shall be less than or equal to 3 lb/sq. ft, with the area taken as the panel coverage area. Include weight and layout of all solar panel components with shop drawings and structural calculations.
- C. Design Data:
  - 1. Calculations to determine the quantity of photovoltaic modules required. Factors relating to building orientation, array tilt and angle, and shading shall be included.



D. Test Reports

1. Test reports in booklet form showing all field tests performed to adjust each component and to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The reports shall include the manufacturer, model number, and serial number of test equipment used in each test. Each report shall indicate the final position of controls and operating mode of the system.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's special materials and workmanship warranty and minimum power output warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For PV modules to include in operation and maintenance manuals.
- B. Submit procedure for commissioning, operating, disconnecting, servicing, and maintaining complete system and individual components. System commissioning shall meet all utility and state rebate programs.

1.8 QUALITY ASSURANCE

- A. Qualifications, Installer: The installing Contractor shall provide the following: NABCEP certified PV Installer to perform the installation of the system. The installer shall have a minimum of 4 years of experience and shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein.
- 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. Third party agencies shall be amongst those accredited by the North Carolina Building Code Council (NCBCC) to Label Electrical & Mechanical Equipment. A list of accredited agencies is available on the NC Department of Insurance's website.

1.9 WARRANTY

- A. Photovoltaic System Warranty
  1. Full Warranty: Furnish a full warranty on all parts and labor for a period of not less than Five (5) years from the date of Final Completion. The warranty shall include all parts and labor, including the cost of removing any defective component, shipping it to

the manufacturer, and reinstalling the component after it is repaired or replaced, and faulty operation of PV modules.

B. Photovoltaic Module Warranty

1. Product Warranty: Furnish the photovoltaic module manufacturer's product warranty. The warranty period shall not be less than twelve (12) years for the product and thirty (30) years for the performance from the date of delivery. The photovoltaic module shall be warranted to be free from defects in materials and workmanship under normal application, installation, use and service conditions. If the photovoltaic modules fail to conform to this warranty, then for a period ending not less than twenty-five (25) years from date of delivery, the manufacturer shall, at its option, either repair or replace the product. The replacement module shall be identical to, or an improvement upon, the original design of the malfunctioning photovoltaic module. The warranty shall state that the replacement module shall be promptly shipped to the Owner.
2. Power Warranty: Furnish the photovoltaic module manufacturer's power warranty. The performance warranty period shall not be less than thirty (30) years from the date of delivery. For not less than the first ten (10) years of the warranty period, the photovoltaic module power output shall be warranted to not drop below 93.5% of the Minimum Peak Power as specified at the date of delivery in the Product datasheet. For not less than the second fifteen (15) years of the warranty period, the photovoltaic module power output shall be warranted to not drop below 86% of the Minimum Peak Power as specified at the date of delivery in the Product datasheet. If the photovoltaic modules fail to conform to this warranty, then for a period ending not less than twenty-five (25) years from date of delivery, the manufacturer shall, at its option, replace such loss in power either by providing additional PV modules to make up such loss in power, or by providing monetary compensation equivalent to the cost of additional PV modules required to make up such loss in power, or by repairing or replacing the defective PV modules. The replacement module shall be identical to, or an improvement upon, the original design of the malfunctioning photovoltaic module. The warranty shall state that the replacement module shall be promptly shipped to the Owner.

C. Inverter Warranty

1. Product Warranty: Furnish the inverter manufacturer's product warranty. The warranty period shall not be less than ten (10) years from the date of delivery. The inverter shall be warranted to be free from defects in materials and workmanship under normal application, installation, use and service conditions. If the inverter fails to conform to this warranty, then for a period ending not less than twenty (20) years from date of delivery, the manufacturer shall, at its option, either repair or replace the product. The replacement inverter shall be identical to, or an improvement upon, the original design of the inverter. The warranty shall state that the replacement inverter shall be promptly shipped to the Owner.

1.10 COORDINATION

- A. Coordinate layout and installation of PV modules with other construction that penetrates roof or is supported by roof, including mechanical equipment, vents and other equipment.

PART 2 - PRODUCTS

2.1 PHOTOVOLTAIC MODULE AND ARRAY (ALTERNATE NO. 1)

- 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. PV Modules: (160) QCell 485s for 77.6 kW-DC
  2. RSD:(80) P1101 Optimizers
  3. Racking: S-5! Standing seam clamps with S5! PVKit attachments
  4. Interconnection Method: Supply Side Connection at spare lugs in Generator Docking Station
- B. PV Module Manufacturer Alternates:
1. JA Solar
  2. SEG Solar
- C. RSD Alternates:
1. AP Systems
  2. NEP
- D. Racking Alternates:
1. Unirac
  2. Iron Ridge
- E. Description: The photovoltaic module shall be a framed flat-plate Monocrystalline; complying with UL 1703/UL 61730.
1. The PV array shall be sized to achieve a nominal 77.6 kW-DC STC output for the entire system under peak sun conditions (1000 W/m2).
  2. The PV module efficiency shall be minimum 20.7 percent.
  3. Each PV module shall include bypass diodes for protection against overheating.
  4. Each PV module shall have class 2 silver anodized frame and high transmission tempered anti-reflective glass front.
  5. PV array mounting hardware shall be compatible with the site considerations and environment. Special attention should be paid to minimizing the risk from exposed fasteners, sharp edges, and potential damage to the modules or support structure. Corrosion resistance and durability of the mechanical hardware should be emphasized –

the use of stainless-steel fasteners and an aluminum support structure is preferred. The use of ferrous metals, wood or plastic components is prohibited. Galvanic corrosion shall be avoided.

6. To prevent excessive temperatures that decrease output and increase module degradation, PV array modules shall be installed with sufficient clearance to allow for proper ventilation and cooling. In no case shall PV modules be mounted less than 4 inches above any surface and an additional inch of clearance for each foot of continuous array surface beyond four feet in the direction parallel to the mounting support surface. Where manufacturer clearance recommendations exceed the aforementioned clearance, the installation shall comply with the manufacturer clearance recommendations.
7. Each PV module shall be provided with Power Optimizer. Power optimizer shall be by SolarEdge, and specifically designed to work with the selected PV module and with SolarEdge inverters.
8. Refer to drawings for additional information.

## 2.2 INVERTER (ALTERNATE NO. 1)

- 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. Inverters: (1) Solar Edge SE50k-US, (1) Solar Edge 17.3k-US (Basis of Design).
2. Alternates:
  - a. Sol-Ark
  - b. Yotta 208V DPI

- B. Description: The inverter shall be designed specifically for utility grid interconnection of photovoltaic arrays and shall be capable of automatic, continuous, and stable operation over the range of voltages, currents, and power levels for the size and type of array used. The inverter shall comply with IEEE 1547 and UL 1741.

1. The inverter shall have an automatic visual indicator showing whether the system is online or not.
2. The inverter shall not operate without the line voltage present. The inverter shall sense a "loss of line" (utility) condition and shall automatically disconnect from the line. The inverter restart shall occur automatically after restoration of line voltage and frequency for at least five minutes.
3. The inverter shall provide maximum power point tracking for the full voltage and current range expected from the photovoltaic panels used and the temperature and solar insolation conditions expected at the project site.
4. The inverter shall be capable of adjusting to "sun splash" from all possible combinations of cloud fringe effects without interruption of electric production.
5. The inverter shall be installed with sufficient clearance to allow for proper ventilation and cooling. The installation shall comply with or exceed the manufacturer clearance recommendations.
6. Integrated DC safety switch.
7. Integral ground-fault isolation detection.

8. The inverter shall be provided with integral arc-fault protection and rapid shutdown per NEC Article 690.
9. Inverter Output Voltage: 208Vac, 3-Phase, 4-wire plus ground, 60 Hz.
10. Operating Conditions: Refer to local conditions stated above.
11. CEC Weighted Efficiency: 97 percent.
12. Communications Interface: RS485, Ethernet.

2.3 PV + 90-MINUTE BATTERY BACKUP FOR PANEL “INV” (ALTERNATE NO. 2)

A. Manufacturers:

1. PV Modules: (160) QCell 485s for 77.6 kW-DC
2. Inverters: (2) Sol-Ark 30kw 208V inverters
3. RSD: (80) NEP PVG-2 RSDs
4. Racking: S-5! Standing seam clamps with S5! PVKit attachments
5. Interconnection method: Supply Side Connection at spare lugs in Generator Docking Station
6. BESS: (1) Sol-Ark L-3 Series 60kWh NEMA 3R Battery Cabinet

B. Module Manufacturer Alternates:

1. JA Solar
2. SEG Solar

C. Inverter Alternates:

1. Sol-Ark
2. Yotta 208V DPI

D. RSD Alternates:

1. AP Systems
2. Tigo

E. Racking Alternates:

1. Unirac
2. Iron Ridge

F. BESS Alternates:

1. Tesla
2. Socomec

2.4 PV + 90-MINUTE BATTERY BACKUP FOR PANEL “MDP” (ALTERNATE NO. 2A)

A. Manufacturers:

1. PV Modules: (160) QCell 485s for 77.6 kW-DC
2. Inverters: (4) Sol-Ark 30kw 208V inverters
3. RSD: (80) NEP PVG-2 RSDs
4. Racking: S-5! Standing seam clamps with S5! PVKit attachments
5. Interconnection method: Supply Side Connection at spare lugs in Generator Docking Station
6. BESS: (2) Sol-Ark L-3 Series 60kWh NEMA 3R Battery Cabinets

B. Module Manufacturer Alternates:

1. JA Solar
2. SEG Solar

C. Inverter Alternates:

1. Sol-Ark
2. Yotta 208V DPI

D. RSD Alternates:

1. AP Systems
2. Tigo

E. Racking Alternates:

1. Unirac
2. Iron Ridge

F. BESS Alternates:

1. Motive Energy Watt I.O
2. Socomec

2.5 MISCELLANEOUS COMPONENTS

- A. All components required to make the system fully operational and in conformance with these specifications shall be provided. All electrical components shall be UL listed.

2.6 FIELD FABRICATED NAMEPLATES

- A. Provide engraved, laminated plastic nameplates for each equipment enclosure, relay, switch, and device. Each nameplate inscription shall identify the function and, when

applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square.

## 2.7 MANUFACTURER'S NAMEPLATES

- A. Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent shall not be acceptable.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Do not begin installation until mounting surfaces have been properly prepared.
- C. If preparation of mounting surfaces is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Examine modules and array frame before installation. Reject modules and arrays that are wet, moisture damaged, or mold damaged.
- E. Examine roofs, supports, and supporting structures for suitable conditions where PV system will be installed.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install photovoltaic components and systems according to NFPA 70.
- C. Install PV inverter, disconnects, circuit breaker and system control in locations indicated on Drawings.
- D. The only roof penetration allowed shall be for the power connection and shall comply with the roof manufacturer's recommendations for penetrations. Seal around openings to make weather tight.

- E. Enclosures for disconnect switches and required electronics shall be pad lockable. Outdoor enclosures shall be NEMA 3R and shall provide venting and weather sealing required for temperature stability of the electronics enclosed.
- F. An AC disconnect means shall be provided on all ungrounded AC conductors and shall consist of a lockable gang operated disconnect clearly indicating open or closed. The switch shall be capable of being visually inspected to determine if the switch is open. The switch shall be clearly labeled "PV SYSTEM SERVICE DISCONNECT."
- G. Series connected strings of photovoltaic modules shall include a series fuse and blocking diodes (to prevent reverse currents). These diodes shall have low voltage drop to meet the maximum voltage drop requirements and shall have voltage and current ratings (at temperature) of no less than twice the open-circuit voltage and short-circuit ratings of the source circuits.
- H. To create a uniform appearance of the array, spacing between individual photovoltaic modules shall be kept to a minimum. Mechanical hardware, conduit, junction boxes and other equipment shall be concealed beneath and/or behind the array.

### 3.3 WIRING INSTALLATION

- A. Wiring shall be listed for a minimum operation of 600 volts and temperature rating of 90° C in wet locations. Current carrying conductors shall be enclosed in conduit.
- B. Ampacity calculations must take into account appropriate de-ratings as required. Appropriate temperature de-ratings for conductors used in module junction boxes must be considered for peak module operating temperatures, as well as de-ratings for instances where more than three current-carrying conductors are enclosed in a conduit.
- C. Size conductors according to manufacturer's written instructions, unless otherwise indicated.
- D. Voltage drop in array DC source circuits shall be limited to manufacturer recommendations, but in no case shall voltage drop exceed two percent (2%), including losses in conductors and through all fuses, blocking diodes and termination points. Voltage drop in the AC side shall not exceed one percent (1%).
- E. Overcurrent devices shall have trip ratings no greater than the de-rated ampacity of the protected conductors.
- F. Connections shall only be made on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Twist on wire splices, crimped, soldered or taped connections shall not be allowed for the required field installed wiring.

### 3.4 CONNECTIONS

- A. Coordinate PV panel cabling to equipment enclosures to ensure proper connections.



- B. Coordinate installation of utility-interactive meter with utility.
- 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-486B.
- D. Make splices, terminations, and taps that are compatible with conductor material.

### 3.5 GROUNDING

- A. Module frames, panel/array support structures, metal enclosures, panelboards and cabinets shall be provided with connections for bonding to a common grounding conductor and terminating at the facility ground connection point.

### 3.6 FIELD QUALITY CONTROL

- A. The Contractor shall notify the Engineer in writing at least 45 calendar days prior to completion of the complete solar electrical (photovoltaic) system installation.
- B. Initial Inspection and Tests: The Owner and the Engineer, shall inspect the completed installation in the presence of the Contractor. The Contractor shall correct construction or installation deficiencies as directed. Perform acceptance checks in accordance with the manufacturer's recommendations and include the following:
  - 1. Compare equipment nameplate data with drawings, specifications, and approved shop drawings.
  - 2. Inspect physical and mechanical condition. Inspect doors, panels, and sections for paint, dents, scratches, fit, and missing hardware. Inspect the displays for scratches, dark pixels, or uneven brightness.
  - 3. Inspect anchorage, alignment, grounding, and required clearances.
  - 4. Verify that fuse sizes and types correspond to drawings.
  - 5. Verify the units are clean.
  - 6. Test all electrical and mechanical interlock systems for correct operation and sequencing.
  - 7. Inspect bolted electrical connections for high resistance using one of the following methods:
    - a) Use a low-resistance ohmmeter.
    - b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
    - c) Perform thermographic survey.
  - 8. Verify operation of forced ventilation where applicable.
  - 9. Verify that vents are clear.
  - 10. Measure the array azimuth orientation and tilt angle using compass and inclinometer.

- C. Acceptance Tests: The Contractor shall perform acceptance tests of the completed installation in the presence of the Owner. Tests shall be conducted on a clear day with the plane of array irradiance at 800 watts per square meter or greater. The Contractor shall correct construction or installation deficiencies as directed. Perform acceptance checks in accordance with the manufacturer's recommendations and include the following tests:
1. Measure the PV Array Open Circuit Voltage (Voc).
  2. Measure the PV Array Short Circuit Current (Isc).
  3. Measure the inverter DC Input voltage and current.
  4. Measure the inverter AC Output voltage, current, and power factor.
  5. Measure the irradiance and module temperature, and calculate the efficiency.
- D. Prepare test and inspection reports.

### 3.7 ADJUSTING

- A. Make necessary adjustments and jumper settings for proper operation of grid tied inverter system.

### 3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the solar electric (photovoltaic) system. In addition, provide a post-installation packet that includes all relevant documents; including, but not limited to production monitoring credentials, specification sheets, manufacturer warranty information, and statement of other applicable warranties.

END OF SECTION 263100

## SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section includes lightning protection system for ordinary structures.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
  - 2. Include raceway locations needed for the installation of conductors.
  - 3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
  - 4. Include roof attachment details, coordinated with roof installation.
  - 5. Calculations required by NFPA 780 for bonding of metal bodies.
  - 6. Coordination with surge protection system shop drawings is required. Refer to Section 262416 "Panelboards".

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Lightning protection cabling attachments to roofing systems and accessories.
  - 2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
  - 3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.
- B. Qualification Data: For Installer.

- C. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.
- D. Field quality-control reports.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For lightning protection system to include in maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations. Comply with requirements of Section 017839 "Project Record Documents."
    - b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.
- B. Completion Certificate:
  - 1. UL Master Label Certificate.
    - a. As required in UL 96A and NFPA 780, include an evaluation of the electrical and telecommunications services surge protection as part of the provision of a UL Master Label of the lightning protection system.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: UL-listed installer, category OWAY.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.
- B. UL Lightning Protection Standard: Comply with UL 96A requirements for Class I buildings.
- C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a third party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
- D. Electrical system surge protection systems shall be evaluated per NFPA 780 Section 4.20. Refer to Section 262416 "Panelboards".

## 2.2 MATERIALS

- A. All lightning protection materials and components shall comply in weight, size and composition with UL 96A and NFPA-780 lightning protection material requirements for this type of structure.
- B. All materials shall be copper, bronze, or stainless steel.
- C. Aluminum components shall be used in locations where system components are mounted to aluminum surfaces to avoid galvanic corrosion of dissimilar metals.
- D. Class I materials shall be used on structures not more than 75 feet in height.
- E. Class II materials shall be used on structures over 75 feet in height.
- F. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install lightning protection components and systems according to UL 96A.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.
- C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed installations in UL 96A.
  - 1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
  - 2. Install conduit where necessary to comply with conductor concealment requirements.
  - 3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

### 3.2 CONNECTIONS

- A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.

- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
- C. The system shall be grounded to the steel frame of the building. This is in addition to ground grid as required by UL.

### 3.3 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Perform inspections as required to obtain a UL Master Label for system.
  - 2. Perform inspections to obtain an LPI certification.
- B. Prepare test and inspection reports and certificates.
- C. Deliver UL Master Label Certificate to Owner.

END OF SECTION 264113

## SECTION 265119 - LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include emergency lighting units, including batteries and chargers.
  - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

- B. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
  2. Suspended ceiling components.
  3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
  4. Structural members to which equipment or luminaires will be attached.
  5. Initial access modules for acoustical tile, including size and locations.
  6. Items penetrating finished ceiling, including the following:
    - a. Other luminaires.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Access panels.
    - e. Ceiling-mounted projectors.
  7. Moldings.
- C. Qualification Data: For testing laboratory providing photometric data for luminaires.
- D. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

## 1.6 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.



1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Project Acceptance.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Ambient Temperature: 41 to 104 deg F.
  - 1. Relative Humidity: Zero to 95 percent.
- C. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment , and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.

2.3 MATERIALS

- A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A 240/240 M.

C. Galvanized Steel: ASTM A 653/A 653M.

D. Aluminum: ASTM B 209.

## 2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece.

## 2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 TEMPORARY LIGHTING

- A. Permanent luminaires are not to be used for temporary lighting.

### 3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
  - 1. Attached to structural members in walls.
  - 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
  - 1. Ceiling Mount:
    - a. Two 5/32-inch-diameter aircraft cable supports adjustable to 10 feet in length.
    - b. Pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 10 feet in length.
    - c. Hook mount.
  - 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
  - 4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  - 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
  2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
  3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
- I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

END OF SECTION 265119

## SECTION 265619 – LED EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
  - 2. Luminaire supports.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaire.

4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  5. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- C. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports and seismic restraints.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
  2. Structural members to which equipment and luminaires will be attached.
  3. Underground utilities and structures.
  4. Existing underground utilities and structures.
  5. Above-grade utilities and structures.
  6. Existing above-grade utilities and structures.
  7. Building features.
  8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.

- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

#### 1.9 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

#### 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.
    - b. Faulty operation of luminaires and accessories.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 2. Warranty Period: 2 year(s) from date of Project Acceptance.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

#### 2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building

Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.

- B. UL Compliance: Comply with UL 1598 and listed for wet location.
- C. Lamp base complying with ANSI C81.61.
- D. CRI of minimum 80.
- E. L70 lamp life of 50,000 hours.
- F. Internal driver.
- G. Nominal Operating Voltage: As indicated on the Drawings.
- H. Lamp Rating: Lamp marked for outdoor use.
- I. Source Limitations: Obtain luminaires from single source from a single manufacturer.

## 2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum or Stainless steel. Form and support to prevent warping and sagging.
- C. 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.
- D. Diffusers and Globes:
  - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. 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.
- G. Housings:



1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
  2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
    - a. CCT and CRI for all luminaires.

## 2.4 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

## 2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine rough-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.

- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Support luminaires without causing deflection of finished surface.
  - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
  - 1. Attached to structural members in walls.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

### 3.3 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 Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.5 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- C. Luminaire will be considered defective if it does not pass tests and inspections.

### 3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Project Acceptance, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions.
  - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619



## SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. A grounding and bonding system supplemental to the electrical power grounding system and devoted to the communications system infrastructure is required.
- B. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding rods.
  - 5. Grounding labeling.

#### 1.3 DEFINITIONS

- A. BCT: Bonding Conductor for Telecommunications.
- B. GE: Grounding Equalizer.
- C. TBB: Telecommunications Bonding Backbone.
- D. TGB: Telecommunications Grounding Busbar.
- E. TMGB: Telecommunications Main Grounding Busbar.
- F. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

## 1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
  - 1. Ground rods.
  - 2. Ground and roof rings.
  - 3. BCT, TMGB, TGBs, and routing of their TBB.
- B. Qualification Data: For installer, installation supervisor, testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Result of the ground-resistance test, measured at the point of BCT connection.
    - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
  - 2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with BICSI TDMM Manual and TIA-607-B.

## 2.2 CONDUCTORS

- A. Comply with UL 486A-486B.
- B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
  - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
  - 2. Cable Tray Equipment Grounding Wire: No. 6 AWG.
- C. Cable Tray Grounding Jumper:
  - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- D. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 Kcmil, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

## 2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
  - 1. Electroplated tinned copper, C and H shaped.
- C. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- D. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

- E. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.4 GROUNDING BUSBARS

- A. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
  - 1. Predrilling shall be with holes for use with lugs specified in this Section.
  - 2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  - 3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- B. Grounding lugs. All lugs shall be two-hole type with both bolts installed. Compression lugs shall be crimped a minimum of two times for each.
- C. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.
  - 1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
  - 2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
  - 3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

## 2.5 GROUND RODS

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

## 2.6 IDENTIFICATION

- A. Comply with requirements for identification products in Section 260553 "Identification for Electrical Systems."



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the electrical grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

### 3.3 APPLICATION

- A. Conductors: Install solid conductor for No. 10 AWG and smaller and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
  - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2 AWG minimum.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches. Grounding conductors may be wall-mounted or fastened to ladder racks with plastic cable ties. They shall not be attached to telecommunications cables in any way.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
  - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

### 3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the electrical service equipment ground shall be sized according to the following table:

BCT Length (LF)	BCT Size (AWG)
Less than 13	6
14-20	4
21-26	3
27-33	2
34-41	1
42-52	1/0
53-66	2/0
Greater than 66	3/0

### 3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.
- B. Bar preparation: Mounting surfaces of the TMGB shall be cleaned with an abrasive pad. A copper-based antioxidant (included in the bar kit) shall be applied prior to installation of mounting lugs.

### 3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  - 1. Use crimping tool and the die specific to the connector.
  - 2. Pretwist the conductor.
  - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install vertically mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB using No. 2 AWG bonding conductors.
- F. Secondary bonding. The TMGB or TGBs shall not be bonded to building steel, water pipes, etc. within the BDF.
- G. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
- H. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- I. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using No. 6 AWG bonding conductors.
  - 1. Install the conductors in grid pattern on 4-foot centers, allowing bonding of one pedestal from each access floor tile.

2. Bond the TGB of the equipment room to the reference grid at two or more locations.
3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.

### 3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Handholes: Install a driven ground rod through handhole floor, close to wall, and set rod depth so 4 inches extends above finished floor. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.

### 3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
  1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
  2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
  3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
  - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.

END OF SECTION 270526



## SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Metallic surface pathways.
5. Boxes, enclosures, and cabinets.
6. Polymer-concrete handholes and boxes for exterior underground cabling.

- B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems"

#### 1.3 DEFINITIONS

- A. GRC: Galvanized rigid conduit.
- B. IMC: Intermediate metal conduit.

#### 1.4 ACTION SUBMITTALS

- A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.
3. Tele-power poles.
4. Boxes, enclosures, and cabinets.
5. Underground handholes and boxes.

- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
  - 3. Underground ducts, piping, and structures in location of underground enclosures and handholes.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.
  - 2. Comply with TIA-569-D.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Compression.
  - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
- G. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.



## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.
- B. General Requirements for Nonmetallic Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 2. Comply with TIA-569-D.
- C. RNC: Type EPC-40-PVC (Type EPC-80-PVC under roadways and drivable surfaces), complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- E. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. General Requirements for Metal Wireways and Auxiliary Gutters:
  - 1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
  - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 3. Comply with TIA-569-D.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.4 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. Finish: Manufacturer's standard enamel finish in color selected by Architect.
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.

## 2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
  - 1. Comply with TIA-569-D.
  - 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
  - 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  - 4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
  - 5. Gangable boxes are prohibited.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- G. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- H. Cabinets:
  - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a third-party agency from amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment, and marked for intended location and application.

## 2.6 POLYMER-CONCRETE HANDHOLES

- A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.
- B. General Requirements for Polymer Concrete Handholes:

1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  3. Comply with TIA-569-D.
- C. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
- D. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  2. Cover Legend: Molded lettering, "COMMUNICATIONS".
- E. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- F. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

### PART 3 - EXECUTION

#### 3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC.
  2. Concealed Conduit, Aboveground: GRC.
  3. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
    - a. Mechanical rooms.
  3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  4. Damp or Wet Locations: GRC.
  5. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
  6. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: 4" Riser-type, optical-fiber-cable pathway.
  7. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway.

- 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 units in damp or wet locations.
- C. Minimum Pathway Size: 1-inch trade size for copper cables, and 1-inch for optical-fiber cables.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA/BICSI 569.
  - 3. TIA-569-D.
  - 4. NECA 101
  - 5. NECA 105.
  - 6. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

- I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Pathways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
  - 3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from nonmetallic conduit and fittings to GRC and fittings before rising above floor.
- M. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- P. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- Q. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- R. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- S. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- T. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
  2. Install surface pathway with a minimum 2-inch radius control at bend points.
  3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- U. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
  2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- V. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service pathway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- W. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- X. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
  2. Install type and quantity of fittings that accommodate temperature change listed for each location.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- Y. Hooks: J-hooks are not allowed for telecommunications cabling.

- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- BB. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set metal floor boxes level and flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Comply with requirements in Section 260543 "Underground Ducts and Raceways for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Comply with requirements in Section 260543 "Underground Ducts and Raceways for Electrical Systems."

### 3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

END OF SECTION 270528



## SECTION 270529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Aluminum slotted support systems for communication raceways.
3. Nonmetallic slotted support systems for communication raceways.
4. Conduit and cable support devices.
5. Support for conductors in vertical conduit.
6. Structural steel for fabricated supports and restraints.
7. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
8. Fabricated metal equipment support assemblies.

- B. Related Requirements:

1. Section 270548 "Seismic Controls for Communications Systems" for products and installation requirements necessary for compliance with seismic criteria.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - a. Slotted support systems, hardware, and accessories.
  - b. Clamps.
  - c. Hangers.
  - d. Sockets.
  - e. Eye nuts.
  - f. Fasteners.
  - g. Anchors.
  - h. Saddles.

- i. Brackets.
  - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for communications hangers and support systems.
  - 1. Trapeze hangers. Include product data for components.
  - 2. Steel slotted-channel systems.
  - 3. Aluminum slotted-channel systems.
  - 4. Nonmetallic slotted-channel systems.
  - 5. Equipment supports.
  - 6. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for communications systems.
  - 1. Include design calculations and details of trapeze hangers.
  - 2. Include design calculations for seismic restraints.
- D. Welding certificates.

#### 1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M.
  - 2. AWS D1.2/D1.2M.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame Rating: Class 1.
  - 2. Self-extinguishing according to ASTM D635.

## 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. ABB, Electrification Products Division.
    - b. Allied Tube & Conduit; Atkore International.
    - c. B-line; Eaton, Electrical Sector.
    - d. CADDY; nVent.
    - e. Flex-Strut Inc.
    - f. Gripple Inc.
    - g. G-Strut.
    - h. Haydon Corporation.
    - i. Metal Ties Innovation.
    - j. MIRO Industries.
    - k. Unistrut; Atkore International.
    - l. Wesanco, Inc.
  - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 3. Material for Channel, Fittings, and Accessories: Plain steel.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  - 6. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel clamps, hangers, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored communications conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

## 2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA 1.
  2. NECA/BICSI 568.
  3. TIA-569-D.
  4. NECA 101.
  5. NECA 102.
  6. NECA 105.
  7. NECA 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
  1. All conduits and wireway entering the telecom room, including between floors, shall be sealed with a smoke barrier.
- C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to NFPA 70.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  1. To New Concrete: Bolt to concrete inserts.
  2. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  3. Instead of expansion anchors, powder-actuated-driven threaded studs, provided with lock washers and nuts, may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  4. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  5. To Light Steel: Sheet metal screws.
  6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor communications materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 270529

## SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. Silicone sealants.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES

- A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized-steel sheet.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.



1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
  4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at pathway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for pathway or cable material and size. Position pathway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pathway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 270544

## SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Backboards.
  - 2. Boxes, enclosures, and cabinets.
  - 3. Power strips.

#### 1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. RCDD: Registered communications distribution designer.
- D. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- E. TGB: Telecommunications grounding bus bar.
- F. TMGB: Telecommunications main grounding bus bar.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings shall be under direct supervision of RCDD.
  - 2. Installation Supervision: Installation shall be under direct supervision of Installer 2, Copper or Fiber, who shall be present at all times when Work of this Section is performed at Project site.
  - 3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

## PART 2 - PRODUCTS

### 2.1 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.
- B. Backboard Paint: Light-colored fire-retardant paint.

### 2.2 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets shall be listed and labeled for intended location and use.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- G. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Plastic.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- H. Cabinets:
  - 1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 POWER STRIPS

- A. Comply with requirements in Section 271116 "Communications Racks, Frames, and Enclosures."

B. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting, with detachable flanges.
3. Height: 1 RU..
4. Housing: Metal.
5. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
6. Front-facing receptacles.
7. LED indicator lights for power and protection status.
8. LED indicator lights for reverse polarity and open outlet ground.
9. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
10. Close-coupled, direct plug-in line cord.
11. Rocker-type on-off switch, illuminated when in on position.
12. Surge Protection: UL 1449, Type 3.
  - a. Maximum Surge Current, Line to Neutral: 72 kA.
  - b. Protection modes shall be line to neutral, line to ground, and neutral to ground.
  - c. UL 1449 Voltage Protection Rating for line to neutral and line to ground shall be 600 V, and 500 V for neutral to ground.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for materials and installation requirements for underground pathways.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Comply with BICSI's "Telecommunications Distribution Methods Manual" for layout of communications equipment spaces.
- C. Comply with BICSI's "Information Technology Systems Installation Methods Manual" for installation of equipment in communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in tracks and in room. Coordinate service entrance configuration with service provider.

1. Meet jointly with systems providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
  2. Record agreements reached in meetings and distribute them to other participants.
  3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize configurations and space requirements of communications equipment.
  4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- G. Backboards:
1. Install from finished floor to 96" above finished floor. Ensure that fire-rating stamp is visible after installation.
  2. Paint all sides of backboard with two coats of paint, leaving all fire rating stamps visible.
  3. Comply with requirements for backboard installation in BICSI's "Information Technology Systems Installation Methods Manual" and TIA-569-D.

### 3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

### 3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with BICSI's "Information Technology Systems Installation Methods Manual," "Firestopping Practices".

END OF SECTION 271100

## SECTION 271116 - COMMUNICATIONS RACKS, FRAMES, AND ENCLOSURES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. 19-inch equipment racks.
  - 2. Power strips.
  - 3. Grounding.
  - 4. Labeling.

- B. Related Requirements:

- 1. Section 271110 "Communications Equipment Room Fittings" for backboards and accessories.
  - 2. Section 270526 "Grounding and Bonding for Telecommunications Equipment" for TMGBs and TGBs.

#### 1.3 DEFINITIONS

- A. Access Provider: An operator that provides a circuit path or facility between the service provider and user. An access provider can also be a service provider.
- B. BICSI: Building Industry Consulting Service International.
- C. LAN: Local area network.
- D. RCDD: Registered communications distribution designer.
- E. Service Provider: The operator of a telecommunications transmission service delivered through access provider facilities.
- F. TGB: Telecommunications grounding bus bar.
- G. TMGB: Telecommunications main grounding bus bar.

#### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.
2. Include rated capacities, operating characteristics, electrical characteristics, certifications, standards compliance, and furnished specialties and accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

#### 1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
2. Field Inspector: Currently registered by BICSI as RCDD to perform on-site inspection.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

A. UL listed.

#### 2.2 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Section 271100 "Communications Equipment Room Fittings."

#### 2.3 19-INCH EQUIPMENT RACKS

A. Description: Two-post racks with threaded rails designed for mounting telecommunications equipment. Width is compatible with EIA/ECIA 310-D, 19-inch equipment mounting with an opening of 17.72-inches between rails.

B. General Requirements:

1. Frames: Modular units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.



2. Material: 6061-T6 aluminum.
3. Finish: Manufacturer's standard, baked-polyester powder coat.
4. Color: Flat Black.

C. Floor-Mounted Racks:

1. Overall Height: 84.
2. Overall Width: 20-5/16 inches.
3. Upright Depth: 3 inches.
4. Two-Post Load Rating: 1200 lbs minimum when load is evenly distributed.
5. Number of Rack Units per Rack: As indicated on Drawings.
6. Threads: 12-24.
7. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
8. Base shall have a minimum of four mounting holes for permanent attachment to floor.
9. Top shall have provisions for attaching to cable tray or ceiling.
10. Self-leveling.

D. Cable Management:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.
4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

- E. Comply with UL 1363 and requirements in Section 271100 "Communications Equipment Room Fittings" for power strips.

## 2.4 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

## 2.5 LABELING

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.

- B. Comply with BICSI TDMM for layout of communications equipment spaces.
- C. Comply with BICSI ITSIMM for installation of communications equipment spaces.
- D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Coordinate layout and installation of communications equipment in racks and room. Coordinate service entrance configuration with service provider.
  - 1. Meet jointly with system providers, equipment suppliers, and Owner to exchange information and agree on details of equipment configurations and installation interfaces.
  - 2. Record agreements reached in meetings and distribute them to other participants.
  - 3. Adjust configurations and locations of distribution frames, cross-connects, and patch panels in equipment spaces to accommodate and optimize configuration and space requirements of telecommunications equipment.
  - 4. Adjust configurations and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in equipment room.
- F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

### 3.2 GROUNDING

- A. Comply with NECA/BICSI 607.
- B. Install grounding according to BICSI ITSIMM, "Bonding, Grounding (Earthing) and Electrical Protection" Chapter.
- C. Locate TGB to minimize length of bonding conductors. Fasten to wall, allowing at least 2 inches of clearance behind TGB. Connect TGB with a minimum No. 4 AWG grounding electrode conductor from TGB to suitable electrical building ground. Connect rack TGB to near TGB or the TMGB.
  - 1. Bond the shield of shielded cable to patch panel, and bond patch panel to TGB or TMGB.

### 3.3 IDENTIFICATION

- A. Coordinate system components, wiring, and cabling complying with TIA-606-B. Comply with requirements in Section 270553 "Identification for Electrical Systems."
- B. Paint and label colors for equipment identification shall comply with TIA-606-B.
- C. Labels shall be machine printed. Type shall be 1/8 inch in height.

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SCO ID# 24-27956-01A  
CN Commission No. 10145  
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END OF SECTION 271116



## SECTION 271513 - COMMUNICATIONS HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Category 6a UPT cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Multiuser telecommunications outlet assembly.
4. Cable management system.
5. Cabling identification products.
6. Grounding provisions for twisted pair cable.
7. Source quality control requirements for twisted pair cable.

#### 1.3 DEFINITIONS

- A. BDF: Building Distribution Frame, or building main telecom room.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- G. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- H. RCDD: Registered Communications Distribution Designer.
- I. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- J. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

- K. UTP: Unscreened (unshielded) twisted pair.

#### 1.4 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
  2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
  3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. Horizontal cables will be installed throughout all spaces. These cables will originate at a BDF room and terminate at telecom outlets (faceplates). The cable type used for the vast majority of locations will be Category 6a UTP cable. For special applications, coax video cables will be installed.
- C. A work area is approximately 100 sq. ft., and includes the components that extend from the equipment outlets to the station equipment.
- D. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Reviewed and stamped by RCDD.
1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
  3. Cabling administration Drawings and printouts.
  4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:
    - a. Telecommunications room plans and elevations.
    - b. Telecommunications pathways.
    - c. Telecommunications system access points.
    - d. Telecommunications grounding system.
    - e. Telecommunications conductor drop locations.

- f. Typical telecommunications details.
  - g. Mechanical, electrical, and plumbing systems.
- C. Twisted pair cable testing plan.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer, installation supervisor, and field inspector.
- B. Product Certificates: For each type of product.
- C. Source quality-control reports.
- D. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.
- B. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On USB media or compact disk, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Connecting Blocks: One of each type.
  - 2. Faceplates: One of each type.
  - 3. Jacks: Ten of each type.
  - 4. Multiuser Telecommunications Outlet Assemblies: One of each type.
  - 5. Patch-Panel Units: One of each type.
  - 6. Plugs: Ten of each type.

#### 1.9 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Cabling Installer must have personnel certified by BICSI on staff.
    - a. Layout Responsibility: Preparation of Shop Drawings, cabling administration Drawings, and field testing program development by an RCDD.

- b. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
      - c. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
    - 2. Tools/equipment: Installation shall be performed using tools and equipment designed for the specific cables. UTP cables may be terminated with standard punchdown tools.
  - B. Testing Agency Qualifications: Testing agency must have personnel certified by BICSI on staff.
    - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD.
- 1.10 DELIVERY, STORAGE, AND HANDLING
- A. Test cables upon receipt at Project site.
    - 1. Test each pair of twisted pair cable for open and short circuits.
- 1.11 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- 1.12 COORDINATION
- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
- 1.13 SOFTWARE SERVICE AGREEMENT
- A. Technical Support: Beginning with Final Acceptance, provide software support for two years.
  - B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Final Acceptance. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
    - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

### 2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:
  - 1. Communications, Non-plenum: Type CMP or Type CMR in enclosed raceway/metallic conduit installed according to NFPA 70, Article 300.22, "Wiring in Ducts, Plenums, and Other Air-Handling Spaces."
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- C. RoHS compliant.

### 2.3 CATEGORY 6a TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.
- B. Standard: Comply with BICSI TDMM manual and TIA-568-C.2 for Category 6a cables.
- C. Conductors: 100-ohm, 23 AWG solid copper.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Cable Rating: Riser.
- F. Jacket: White thermoplastic.

## 2.4 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. General Requirements for Twisted Pair Cable Hardware:
  - 1. Comply with the performance requirements of Category 6a.
  - 2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  - 3. Cables shall be terminated with connecting hardware of same category or higher.
- C. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.
- D. Connecting Blocks:
  - 1. 110-style IDC for Category 6a.
  - 2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.
- E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
  - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
  - 1. Features:
    - a. Universal T568A and T568B wiring labels.
    - b. Labeling areas adjacent to conductors.
    - c. Replaceable connectors.
    - d. 24 or 48 ports.
  - 2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
  - 3. Number of Jacks per Field: One for each four-pair cable indicated.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.
  - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.
  - 2. Patch cords shall have color-coded boots for circuit identification.
- H. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.
3. Marked to indicate transmission performance.

I. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

J. Faceplate:

1. Two port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
  - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.5 TELECOMMUNICATIONS OUTLET

- A. Description: MUTOAs shall meet the requirements of "Twisted Pair Cable Hardware" Article.
- B. Mounting: Wall.
- C. NRTL listed as complying with UL 50 and UL 1863.
- D. Label shall include maximum length of work area cords, based on TIA-568-C.1.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.7 GROUNDING

- A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-B.

## 2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA-568-C.1.
- C. Factory test twisted pair cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays, except within consoles, cabinets, desks, and counters. Conceal raceway and cables, except in unfinished spaces.
  - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
  - 2. Comply with requirements for raceways and boxes specified in Section 270528 "Pathways for Communications Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

### 3.2 INSTALLATION OF PATHWAYS

- A. Comply with requirements for demarcation point, cabinets, and racks specified in Section 271116 "Communications Racks, Frames and Enclosures."
- B. Comply with Section 270528 "Pathways for Communications Systems."
- C. Comply with Section 270529 "Hangers and Supports for Communications Systems."
- D. Drawings indicate general arrangement of pathways and fittings.

### 3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. MUTOA shall not be used as a cross-connect point.
7. Consolidation points may be used only for making a direct connection to equipment outlets:
  - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
  - b. Locate consolidation points for twisted-pair cables at least 49 feet from communications equipment room.
8. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
9. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
10. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
11. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
12. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.
13. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
14. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.

C. Open-Cable Installation:

1. All horizontal cabling will be non-plenum type and shall be installed inside an enclosed raceway/conduit system. Cabling shall be installed end-to-end (no splices) according to standard industry practices.
2. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
3. Cables shall be routed at the BDF end as follows: Route horizontal cables from entry points into BDF to nearest ladder rack. Fasten cables to overhead ladder racks to reach

- equipment racks where cables are to be terminated. Install an additional 10-foot (minimum) cable slack loop in each cable run and fasten to overhead ladder racks. Route cables neatly, parallel to each other, and secure with velcro-type cable wraps to the ladder rack system. Install cables down from ladder racks via dropouts into the rear channel of vertical managers. Cables to be terminated on the left half of patch panels should be routed down the left vertical manager and those to be terminated on the right half of patch panels down the right vertical manager. Dress cables to the rear of each patch panel by fanning out and attaching to the cable management bar installed behind each patch panel.
4. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
  5. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Group connecting hardware for cables into separate logical fields.

E. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
  - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
  - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
  - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.4 OUTLET TERMINATIONS

#### A. User Workstation Outlets

1. Terminations shall be completed per manufacturer specifications, using TIA-568A pinouts, and as follows:
  - a. Station End: Outlets shall be terminated with a standard two-gang faceplates, or white modular furniture faceplates. The upper and lower positions shall be terminated with a Category 6a jacks.
  - b. BDF End: Beginning in the upper-most patch panel in the first horizontal cross-connect rack, terminate each outlet starting from the left end of the panel. Terminate each cable with a Category 6a jack with its color corresponding to the jack color on the station end. Install jacks only in patch panel positions where outlets exist.

### 3.5 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with "Firestopping Systems" Article in BICSI's "Telecommunications Distribution Methods Manual."
- D. Firestopping material shall be installed inside all wireways which enter each BDF/IDF after installation of the horizontal cabling is completed to form smoke barriers.
- E. Malleable foam-type bricks that can be cut to fit shall be used. Putty or mineral wool shall not be used. Slots should be cut to allow the bricks to form tightly around cables.
- F. Firestopping is not required inside 1" homerun conduits serving single outlets.

### 3.6 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 4 AWG grounding electrode conductor.

- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

### 3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Electrical Systems."
  - 1. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.
- B. Paint and label colors for equipment identification shall comply with TIA-606-B.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.
- E. Cable and Wire Identification:
  - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
  - 4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware.
- F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:
  - 1. Cables use flexible vinyl or polyester that flexes as cables are bent.



### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
  - 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- E. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.
- F. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- G. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- H. Prepare test and inspection reports.

### 3.9 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Final Project Acceptance, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project Acceptance. Install and program software upgrades that become available within two years from date of Final Project Acceptance. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

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SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

END OF SECTION 271513

## SECTION 275319 - DISTRIBUTED ANTENNA SYSTEM (DAS)

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. This specification describes technical and performance criteria for deploying a Neutral-Host Distributed Antenna System (DAS) capable of supporting Public Safety Networks (PSN). The DAS components specified in this document include: Donor Antennas, Coverage Antennas, Coax Cable, Coax Connectors, Splitters, Combiners, Couplers, Fiber-Optic Cable, Fiber-Optic Connectors, and Fiber-Optic Jumpers, Bi-Directional Amplifiers (BDA), Fiber-Optic Master Unit and Fiber-Optic Remote Units.

#### 1.2 ABBREVIATIONS AND ACRONYMS

- A. ACG: Automatic Gain Control
- B. AHJ: Authority Having Jurisdiction
- C. ATP: Acceptance Test Plan
- D. AWS: Advanced Wireless Service
- E. BDA: Bi-Direction Amplifier
- F. BOM: Bill-of-Material
- G. BRS: Broadband Radio Service
- H. BTS: Base Transceiver Station
- I. CDMA: Code Division Multiple Access
- J. C/N: Carrier-to-Noise Ratio
- K. CWDM: Coarse Wave Division Multiplexing
- L. DAS: Distributed Antenna System
- M. DASD: DAS System Designer
- N. DWDM: Dense Wave Division Multiplexing
- O. EBS: Educational Broadband Service
- P. ESMR: Enhanced Specialized Mobile Radio

- Q. FCC: Federal Communications Commission
- R. GUI: Graphical User Interface
- S. iDEN: Integrated Enhanced Digital Network
- T. LMR: Land Mobile Radio
- U. LTE: Long Term Evolution
- V. MTBF: Mean Time Between Failure
- W. NFPA: National Fire Protection Association
- X. NMS: Network Management System
- Y. PCS: Personal Communications System
- Z. PSN: Public Safety Network
- AA. RoF: Radio-over-Fiber
- BB. RoHS: Restriction of Hazardous Substances
- CC. RSL: Received Signal Level
- DD. SISO: Single-Input, Single-Output
- EE. SMR: Specialized Mobile Radio
- FF. SMS: Short Message Service
- GG. SNIR: Signal-to-Noise Interference Ratio
- HH. SNMP: Simple Network Management Protocol
- II. SOW: Statement of Work
- JJ. VSWR: Voltage Standing Wave Ratio

### 1.3 DEFINITIONS

- A. Acceptance: Expressed approval by the customer
- B. Active: DAS components that require AC/DC power for operation
- C. Carrier Approval: Expressed approval to interconnect to the WSP macro network
- D. Channel: A path for an RF transmission between two points

- E. Component: A main system element of the DAS
- F. Contractor: The prime contractor bidding the project
- G. Passive: DAS components that do not require AC/DC power for operation

#### 1.4 INITIAL BUILDING COVERAGE EVALUATION

- A. An initial building coverage evaluation shall be performed by a qualified radio-frequency engineer to conduct an evaluation of the structure within 30 days from when the interior has been sealed from the elements. Exterior walls, roofs and windows shall be completed prior to evaluation and at least 80% of the interior walls shall be complete. Copies of building floor plans shall be provided by the contractor to the radio-frequency engineer for the purpose of performing this evaluation.
- B. Evaluation Procedure:
  - 1. Floor plan shall be divided in to 25-foot by 25-foot grids. A minimum of 40 grids are required.
  - 2. Radio engineer shall perform a walk-through of the facility using a calibrated spectrum analyzer, service monitor (or other appropriate radio frequency signal measuring equipment). Received (downlink) signal strength of the active control channel of the county's public safety radio system shall be recorded in each grid. Control channel information will be provided by the County radio engineer to the engineer performing the evaluation.
  - 3. Each grid shall be tested only once and may not be retested if the first attempt fails. Testing shall occur in the center of each grid wherever possible.
  - 4. If test results meet all of the following minimum standards then there is no immediate need for an in-building system.
    - a. Delivered audio quality (DAQ) 3.4 or equal to or better as defined by TIA TSB 88 in 95% or more of all tested grids.
    - b. Recorded downlink signal strength of -95dBm or better in 95% or more of all tested grids.
  - 5. Final test results shall be submitted to the county radio engineer in electronic form. Results shall clearly show the floor plans, grids, and measurements taken in each grid. The evaluation engineer shall also provide certification that the results are accurate and that the test either passed or failed based on the requirements above.
  - 6. If the evaluation reveals that there is insufficient radio coverage within the structure based on the requirements above or if the general contractor fails to conduct such a test within 30 days of finishing the exterior walls, windows, and roof plus 80% of interior walls, then the general contractor shall be responsible for the installation of an in-building coverage system meeting this specification.
- C. Final Acceptance Coverage Testing

1. Final acceptance coverage testing shall be performed following procedures identical to those specified for initial building coverage evaluation.
2. The acceptance test procedure of NC Fire Code Section 510.5.3 must be performed once upon completion of the emergency responder radio coverage system.
3. Final test results shall be submitted to the county radio engineer in electronic form. Results shall clearly show the floor plans, grids, and measurements taken in each grid. The evaluation engineer shall also provide certification that the results are accurate and that the test either passed or failed based on the requirements above.
4. If final acceptance tests reveal that there is insufficient radio coverage within the structure based on test procedures described in this specification, then the contractor shall be responsible for making improvements to correct the deficiencies. Deficiencies shall be corrected within 30 days of written notification of failed test results.
5. Final acceptance coverage testing shall be repeated in its entirety after system corrections have been made by contractor.

D. Visual Inspection

1. In addition to the coverage study the final acceptance test will consist of a visual inspection of all components by a building inspector. If any inspector determines that the installation does not meet code, safety, or grounding requirements, or any specific requirements defined by this standard, the contractor shall be notified in writing, and corrections shall be completed by contractor within 30 days of this written notification. After the corrections have been made, the entire final acceptance test procedure will be repeated.

E. Interference

1. The DAS shall not degrade the operation of the county's public safety radio system nor any other FCC-licensed wireless systems. If it is determined the system is causing harmful interference within the first year of operation after system acceptance, the contractor will be responsible for making the corrections necessary to eliminate the interference.

1.5 DELEGATED DESIGN

- A. The Contractor shall employ the services of a 3rd party entity specializing in the design and deployment of Distributed Antenna Systems that are similar in scope and complexity compared to the system described in this specification. The DAS designer and lead installation personnel must meet the minimum qualifications of NC Fire Code Section 510.5.2. This entity, referred to hereafter as the DAS Designer (or DASD) shall be responsible for the design and deployment of the Distributed Antenna System for this project. Services shall include, but are not limited to the development of a complete DAS design, site evaluation and building analysis, functional system testing, product data submittal preparation and shop drawing submittal preparation. System requirements contained herein shall serve as a basis of design for products and services to be provided for this project by the DASD. Contact the Engineer of Record concerning products or system requirements that are determined by the DASD to be different than those specified in this document.

## 1.6 SYSTEM DESCRIPTION

- A. Services: Upon commissioning, the DAS shall provide complete building interior coverage for the PSNs listed below on all frequencies currently being used by the designated PSN in the given market.

1. (Example) 800 MHz PSN coverage, city of Grapevine, TX Ordinance No. 109.2

- B. Expansion: Without replacing the Passive DAS Infrastructure, the DAS shall have expansion capabilities to support the following PSN frequencies deployed in a SISO antenna environment. Any additional Components required for system expansion shall comply with all specifications of this Section.

<u>Service</u>	<u>Radio Spectrum</u>
700 Band	769-805 MHz
800 Band	806 – 870 MHz

- C. PSN Approval: The Contractor shall propose and deploy a DAS system capable of receiving approval of the PSN Authority Having Jurisdiction (AHJ).
- D. Broadband Active Distribution: Single-mode fiber-optic cable will be used for Active distribution. In-line amplifiers are not allowed.
- E. Network Management:
1. NMS: The DAS shall have a Network Management System (NMS) capable of alarm, monitor, configuration and control of all Active Components.
2. SNMP Integration: The DAS NMS shall be capable of integration with 3rd party SNMP based NMS products for alarm purposes and provide alarming information.

## 1.7 ALTERNATIVES

- A. The products listed in this specification represent the Basis of Design Products for the system. Subject to compliance with requirements herein, provide products of comparable function. Alternative products shall be accepted as equal to the components and manufacturers specified in this document when the Contractor proves that the alternative products are of equal or superior specifications and quality, and that they have been used in similar projects of size and complexity for no less than 3-years. The following information shall be required for each alternative component with submittal of the bid response:

1. Passive Components:
- a. Product samples
- b. Detailed product specifications
- c. Independent test results verifying the product specifications

- d. Written documentation from the manufacturer guaranteeing that the alternative component(s) shall remain available for new purchase for a period of 7-years from the date of system acceptance.
2. Active Components:
  - a. Hardware and software manuals
  - b. Detailed product specifications
  - c. Mean Time Between Failure (MTBF) data for each Active Component
  - d. Independent test results verifying the product specifications
  - e. Written documentation from the manufacturer guaranteeing that the alternative component(s) shall be supported for a period of 7-years from the date of system acceptance.
  - f. For Active Components serving the PSN, written documentation from the AHJ that the alternative component(s) are approved for use within the PSN and that system acceptance of the DAS to the PSN will not be withheld due to the alternative component being used in the DAS.

## 1.8 CODES, STANDARDS AND CERTIFICATIONS

- A. All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation, workmanship, maintenance and testing shall comply with the latest editions of the National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractor's Association (NECA) Standard of Installation. In case of discrepancy or disagreement between the documents noted above, the contractor shall satisfy the most stringent requirements.
- B. Requirements set forth by first-responder code, ordinance, or the PSN AHJ shall supersede the requirements described herein and shall be met in their entirety. It is the Contractor's responsibility to ensure that the DAS complies with local code, ordinances or requirements established by the PSN AHJ.

## 1.9 PERFORMANCE REQUIREMENTS

- A. PSN DAS:
  1. The PSN DAS shall comply with NFPA-1 2015 Edition.
  2. Contractors shall state the assumed channel count for the PSN Frequency Bands, identified in "System Description" paragraph, with submittal of bid response. Prior to installation, contractors shall confirm the channel count and frequencies with the AHJ, and shall guarantee coverage for these channels per the criteria stated above.
  3. The DAS shall be capable of upgrade, without additional hardware or software, to allow for changes to system frequencies within the deployed frequency band in order to maintain radio system coverage as originally designed.
  4. The contractor shall explain the method used to avoid downlink and uplink interference.
  5. The Contractor shall be responsible for ensuring the system maintains adequate isolation. A minimum margin of 20 dB in-band isolation is required.



1.10 ADDITIONAL REQUIREMENTS

- A. PSN Approval: Submit design documents concurrently to the Engineer and the designated State Construction Office representative for this project. Approval is required from the Engineer and State Construction Office representative prior to purchasing and installation.

1.11 INFORMATIONAL SUBMITTALS

- A. Submittal Requirements with Bid Response: Submit information below in both paper copy and electronic form.

- 1. Product Data: Submit manufacturer datasheets for the following components (highlight product part numbers):
  - a. Donor and Coverage Antennas
  - b. Coaxial Cable and Connectors
  - c. Splitters, Combiners and Couplers
  - d. Bi-Directional Amplifiers (BDA)
  - e. Fiber-Optic Master Unit
  - f. Fiber-Optic Remote Units
- 2. Shop Drawings: Submit the following items:
  - a. RF link budget
  - b. Overlay of system Components on floor plans
  - c. Interconnection Diagrams
  - d. Equipment Rack Elevations
  - e. Equipment Power Requirements
  - f. Drawings for Donor Antenna and grounding
  - g. Bill-of-Material (BOM)
- 3. Statement of Work (SOW): Submit sample SOW
- 4. Acceptance Test Plan (ATP): Submit sample ATP
- 5. Additional recommended spare components beyond those listed in this specification.
- 6. Initial Evaluation Test Reports
- 7. Warranty Documents:
  - a. Submit for all manufactured Components specified in this Section.
  - b. Submit Contractor's System Warranty.
  - c. Submit Manufacturer's Extended Warranty.
- 8. Submit qualification data for the DAS designer and lead installation personnel must indicating that the minimum qualifications of NC Fire Code Section 510.5.2 are met.

- B. Submittal Requirements Prior to Start of Construction

- 1. Final RF link budget
- 2. Overlay of system Components on floor plans
- 3. Project Implementation Plan (Include proposed installation schedule).

4. Drawings for Donor Antenna and grounding
5. RF propagation modeling
6. Signal to Noise Interference Ratio (SNIR) Map
7. Bill-of-Material (BOM)
8. Maintenance Service Contract
9. Statement of Work (SOW): The contractor shall submit a SOW that has been accepted by the customer or customer's designated representative.
10. Acceptance Test Plan (ATP): The contractor shall submit an ATP that has been accepted by the customer or customer's designated representative.

C. Submittal Requirements at Close Out

1. Drawings: Submit as-built drawings indicating:
  - a. Donor antenna, grounding and lightning protection details
  - b. Cable routing, splitters, couplers and coverage antenna locations
  - c. Active component locations, layout and configuration
2. Test Reports
  - a. PSN: Submit Accepted ATP reports confirming that system performance requirements are in accordance with "Performance Requirements" section of this specification.
3. Field Reports: Submit sweep-testing results for all cable runs.
4. Field Reports: Submit OTDR test results for all fiber runs.
5. Field Reports: Donor antennas shall be measured for VSWR throughout the operating range.
6. Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.
7. Warranty Documents:
  - a. Submit for all manufactured components specified in this Section.
  - b. Submit Contractor's System Warranty.
  - c. Submit Manufacturer's Extended Warranty
  - d. BDA gain and system configuration settings
  - e. System acceptance sign-off.

1.12 QUALITY ASSURANCE

A. Qualifications:

1. Contractor, and/or Sub-Contractors, shall have a minimum of 5-years full-time experience executing work of similar scope and complexity.
2. DAS Designer shall have a minimum of 5-years full-time experience executing work of similar scope and complexity.
3. The DAS designer and lead installation personnel must meet the minimum qualifications of NC Fire Code Section 510.5.2.

B. Certifications:

- a. Passive Components: Contractor or Sub-Contractor shall provide manufacturer certification that their personnel have been trained on the components being installed.
- b. Active Components: Contractor or Sub-Contractor shall provide manufacturer certification that their personnel have been trained on the components being installed.
- c. DAS Design: Provide documentation indicating projects of similar design and complexity have been successfully completed by DAS Designer. No fewer than 5 project examples shall be submitted as references.

1.13 WARRANTY

A. Manufacturer Warranty:

1. Splitters, Couplers and Coverage Antennas: 5-year limited warranty from date of system acceptance.
2. Coaxial Cable and Connectors: 10-year limited warranty from date of system acceptance.
3. Fiber-Optic Cable: 20-year limited warranty from date of system acceptance.
4. Active Components: 1-year limited warranty from date of system installation.

B. Contractor Warranty: Contractor shall warrant the system performance (as described in the "Performance Requirements" section of this specification) for a period of 1-year beginning on the date of final system acceptance by the AHJ. The Owner shall not incur additional cost to repair or replace system components that fail during this warranty period. During this warranty period, on-site service shall be available within 24 hours of notification from client.

C. Manufacturers Extended Warranty:

1. Assurance Warranty: Assurance program shall warrant the certified system to support current and future modulation formats in the frequency bands for which it is designed. The warranty period shall be 20 years from date of final system acceptance by the AHJ.
2. In the event that the certified system ceases to support the certified application(s), whether at the time of ATP, during normal use, or when upgrading to additional frequency bands, the manufacturer and Contractor shall commit to implement corrective action within 24 hours of notification from Client.
3. Manufacturer shall maintain ISO Quality Control registration for the facilities that manufacture the products used in the DAS.

1.14 MAINTENANCE

- A. The Contractor shall provide an optional maintenance service contract, covering for a period of one-year: preventative maintenance, system monitoring, spares, fault mitigation, equipment repair, and response time.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Specified Manufacturer: CommScope/Andrew
- B. Acceptable Manufacturers: As permitted in “Alternates” section of this specification.

### 2.2 COMPONENTS

- A. Broadband Donor Antennas: Broadband Donor Antennas shall feature a multi-band design, accommodating LMR frequencies in a single small antenna.
- B. Yagi Style Donor Antennas:
  - 1. Electrical:
    - a. Frequency band, 769-870 MHz
    - b. VSWR  $\leq$  1.5:1
    - c. Gain:  $\geq$  11.1 dBi
    - d. Maximum input power: 100 watts
    - e. Polarization: Vertical
    - f. Front-to-back ratio:  $\geq$  15 dB
    - g. Impedance: 50  $\Omega$
    - h. Beamwidth, Horizontal, degrees: 60
    - i. Azimuth Pattern: As proposed by the manufacturer to meet the performance specifications in this Section.
  - 2. Mechanical:
    - a. Connector: 50  $\Omega$  N Type Female
    - b. Mounting: Pole
  - 3. Environmental:
    - a. Temperature: -40 °C to +60 °C
    - b. Lightning protection and Grounding: In accordance with Motorola R56, Standards and Guidelines for Communication Sites
    - c. Waterproof level: IP 66
    - d. Wind Speed, maximum: 125 mph
  - 4. Approved Manufacturer: Andrew DB498-PS or equivalent in accordance with “Performance Requirements” section of this specification.
- C. Omni-Directional Coverage: Omni-Directional Coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.

1. Electrical Band 1 (700 MHz Spectrum):
    - a. Frequency Band: 769–805 MHz
    - b. VSWR:  $\leq 1.5:1$
    - c. Gain:  $\geq 1.5$  dBi
    - d. Maximum input power:
    - e. Impedance:  $50\ \Omega$
    - f. Beamwidth, Horizontal:  $360^\circ$  omnidirectional
    - g. Beamwidth, Vertical:  $80^\circ$  nominal
    - h. Return Loss: 10.9 dB
  2. Electrical Band 2 (800 MHz Spectrum):
    - a. Frequency Band: 806–870 MHz
    - b. VSWR:  $\leq 1.5:1$
    - c. Gain:  $\geq 1.5$  dBi @ 806–870 MHz
    - d. Maximum input power:
    - e. Impedance:  $50\ \Omega$
    - f. Beamwidth, Horizontal:  $360^\circ$  omnidirectional
    - g. Beamwidth, Vertical:  $65^\circ$  nominal
    - h. Return Loss:  $\leq 13.9$  dB
  3. Mechanical:
    - a. Connector:  $50\ \Omega$  N Type Female
    - b. Mounting: Thru-hole ceiling mount
    - c. Radome material: ABS, UV resistant
    - d. Pigtail cable: KSR195, plenum rated
  4. Environmental:
    - a. Application: Indoor
    - b. Operating Temperature:  $40^\circ\text{C}$  to  $+60^\circ\text{C}$  ( $40^\circ\text{F}$  to  $+140^\circ\text{F}$ )
    - c. Relative Humidity: Up to 100%
  5. Regulatory Compliance/Certifications: RoHS 2002/95/EC
  6. Approved Manufacturer: Andrew CELLMAX-O-CPUSE or equivalent, in accordance with “Alternates” section of this specification.
- D. Directional Coverage Antennas: Directional coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.
1. Electrical Band 1 (700 MHz Spectrum):
    - a. Frequency Band: 769–805 MHz
    - b. VSWR:  $\leq 1.5:1$
    - c. Gain:  $\geq 5.0$  dBi @ 769–805 MHz
    - d. Maximum input power: 50W
    - e. Impedance:  $50\ \Omega$

- f. Beamwidth, Horizontal: 110° nominal
    - g. Polarization: Vertical
    - h. Return Loss:  $\leq 10.9$  dB
  - 2. Electrical Band 2 (800 MHz Spectrum):
    - a. Frequency Band: 806–870 MHz
    - b. VSWR:  $\leq 1.5:1$
    - c. Gain:  $\geq 5.0$  dBi @ 806–870 MHz
    - d. Maximum input power:
    - e. Impedance: 50  $\Omega$
    - f. Beamwidth, Horizontal: 90° nominal
    - g. Return Loss:  $\leq 13.9$  dB
  - 3. Mechanical:
    - a. Connector: 50  $\Omega$  N Type Female
    - b. Mounting: 4-hole wall mounting plate
    - c. Radome material: ABS, UV resistant
    - d. Pigtail cable: RG58, plenum rated
  - 4. Environmental:
    - a. Application: Indoor
    - b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
    - c. Relative Humidity: Up to 100%
  - 5. Regulatory Compliance/Certifications: RoHS 2002/95/EC
  - 6. Approved Manufacturer: Andrew CELLMAX-D-CPUSE or equivalent, in accordance with “Alternates” section of this specification.
- E. Fiber-Optic Cable and Connectors:
- 1. General Specifications:
    - a. Cables shall be six-strand or greater, designed for point-to-point applications as well as mid-span access, and shall provide a high-level of protection for optical fiber installed in interior building environments.
    - b. Higher optical fiber count cables shall utilize a sub-unitized design with color-coded subunits for easy identification.
    - c. Single-mode optical fibers shall be 8.3  $\mu\text{m}$  and use standard colored tight-buffered construction.
    - d. The single-mode optical fiber shall be dispersion-unshifted optical fiber that meets ITU-T G.652c standards.
    - e. Cable shall provide optimum performance over entire wavelength range from 1260 to 1625 nanometers.
    - f. Cable shall support new and emerging applications that utilize extended E band, 1360 to 1460 nanometers.

- g. Cable shall also support existing and legacy single-mode applications that traditionally operate in 1310 and 1550 nanometer regions.
- h. Cable shall deliver a cost-effective upgrade path by expanding available wavelengths by 50 percent supporting 16 Channels of coarse wave division multiplexing (CWDM) on a single optical fiber and up to 400 Channels of dense wave division multiplexing (DWDM) on a single cable.
- i. Fire ratings: Riser, plenum, and/or LSZH
- j. Approved Manufacture: CommScope Fiber Optic Cable containing TerraSpeed Single Mode Optical Fiber. As an example, P-006-BO-8W-F25YL, 6-strand breakout cable single-mode Fiber or equal in accordance with “Alternates” section of this specification.

F. Fiber-Optic Pigtails:

1. General Specifications:

- a. To maintain channel integrity, optical fiber patch cords and pigtails shall be fabricated to meet the performance parameters corresponding to the optical fiber cable approved product type specified below. Patch cord and pigtail plug connectors shall be equipped with boots, and shall have same colors as related optical fiber backbone cables, unless specified or indicated otherwise. Optical fiber patch cords and pigtails shall be available with the following options as specified or indicated:
  - 1) Termination types: SC-APC
  - 2) Connector/cable configuration: Simplex and duplex
  - 3) Fire ratings: Riser, plenum and/or LSZH
  - 4) Patch cord outside diameters: 1.6 millimeters (0.063 inches) and 3.0 millimeters (0.118 inches)
  - 5) Pigtails: Ruggedized and tight-buffered optical fiber—0.9 millimeters (0.035 inches) outside diameter
  - 6) Lengths: As specified or indicated
  - 7) Approved Manufacturer: CommScope RFT-01RF09-8W-SCA-XX, single reinforced buffered 900  $\mu$ m, LightScope ZWP single-mode fiber, angled polished connector or equivalent, in accordance with “Alternates” section of this specification.

G. Plenum Rated Foam Dielectric Coaxial Cable:

1. Material Characteristics:

- a. Jacket: Non-halogenated, Fire-Retardant Ployolefin
- b. Outer Conductor Material: Corrugated Copper
- c. Inner Conductor Material: Copper-Clad Aluminum Wire

2. Electrical Characteristics:

- a. Impedance:  $50 \pm 1.0 \Omega$

- b. Frequency Band: 1/2" Nominal: 1 - 8800 MHz, 7/8" Nominal: 1 - 5000 MHz
  - c. Peak Power Rating:  $\geq 40.0$  kW
3. Mechanical Characteristics:
- a. Diameter Over Jacket: 1/2" Nominal:  $\leq .625$  in
  - b. Minimum Bending Radius: 1/2" Nominal:  $\leq 5$  in
  - c. One Time Minimum Bending Radius: 1/2" Nominal:  $\leq 2$  in
4. Attenuation Characteristics: 1/2" Nominal

Frequency (MHz)	Attenuation (dB/100ft)
150	$\leq 0.815$
450	$\leq 1.447$
700	$\leq 1.831$
800	$\leq 1.968$
2000	$\leq 3.251$

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

5. Approved Manufacturer: Commscope, Heliac Brand #LDF4-50A or equivalent, in accordance with "Alternates" section of this specification.

H. Splitters, Combiners, Couplers, Coax Jumpers and Connectors:

1. Approved Manufacturer: Andrew or equivalent, in accordance with "Alternates" section of this specification.

I. BDA: When the AHJ dictates a BDA to drive the DAS, the BDA shall be of modular design and use digital filtering to mitigate interference and accommodate multiple services for PSNs.

1. Characteristics

- a. Operating Temperature Range: -33 °C to +50 °C
- b. Chassis: Shall be of modular design with  $\geq 4$  frequency bands per 19" chassis. Chassis shall not exceed four Rack Units (RUs) in height.
- c. Filtering: Digital
- d. Separate Control: Each RF amplifier shall be capable of adjusting and controlling power levels for each WSP when multiple WSPs share a single amplifier.
- e. FCC Part 90.219 Type Classification: Class A narrowband for LMR/SMR/ESMR frequency bands
- f. Alarming: Shall support both SNMP and SMS using wireless modem
- g. Mounting Options: shall support rack, wall and pole mounting
- h. Frequency Bands Supported:
  - 1) 769 - 805 MHz LMR
  - 2) 806 - 870 MHz LMR/SMR/ESMR



2. Compliance:
    - a. NFPA: The BDA shall comply with NFPA-1 2015 edition Annex O In-Building Public Safety Radio Enhancement Systems.
    - b. FCC: Shall be FCC type certified.
  3. Approved Manufacturer: Commscope Node A4 or approved equivalent.
- J. Surge Suppression: Surge suppression shall be provided for each coaxial cable from roof mounted donor antennas to head-end equipment in telecommunications room. Surge suppressors shall be installed at the telecommunications room end of the cable and bonded to telecommunications room ground bar using #6 AWG, green-insulated grounding copper conductor. Cables shall be terminated at suppressors prior to connection at head-end amplifier.
- K. Donor Antenna Redundancy Switch:
1. Functional Description: Dual channel redundancy switch with automatic sensing, designed for installation in standard EIA 19-inch equipment frame. Switch shall accept input from two individual donor antennas, and shall monitor the signal health from both antennas. One antenna shall be designated as the primary (default) antenna. The other antenna shall be designated as standby. Switch shall transfer to standby antenna if signal strength from primary antenna falls below specified parameters. Switch shall automatically switch back to primary antenna once signal strength is restored to primary antenna. Switching between primary and standby antenna shall be seamless.
  2. Manufacturers: DEV Systemtechnik or equivalent, in accordance with "Alternates" section of this specification.
- L. Fiber-Optic Master Unit: When building size dictates an Active fiber DAS, the Fiber-Optic Master Unit shall convert radio over coax to Radio-Over-Fiber (RoF) for distribution to Fiber-Optic Remote Units.
1. Characteristics
    - a. Transmission Media: Single-mode fiber at 1310 nm
    - b. Operating Temperature Range: +5 °C to +40 °C
    - c. Impedance: 50  $\Omega$
    - d. Chassis:
      - 1) Shall be of modular design capable of supporting  $\geq 32$  Remote Units per 19", 4 RU chassis
      - 2) Shall support redundant power supplies
      - 3) Shall have the capability to remotely power the Remote Units via composite fiber-optic cable
    - e. Automatic Gain Control (AGC): Shall provide AGC for optical loss compensation
    - f. Optical Budget: Shall support  $\leq 3$  dB optical budget (~3 km or 2 miles)
    - g. Auxiliary Channel: Shall provide an input to support 400 to 2700 MHz for future expandability

- h. Interlink: Shall support one fiber or two fibers bi-directional optical link for distances up to 20 km with a 10 dB optical budget
  - i. Remote Supervision:
    - 1) Shall support the TCP/IP protocol, SNMPv2, FTP, HTTP, Telnet, and be fully compatible with general purpose SNMP managers
    - 2) Remote access shall be available via Point-to-Point Protocol (PPP), over circuit-switched/packet data and wired/wireless modems
    - 3) Each Active device shall be manageable via a Web GUI
    - 4) Auto Mapping: Each board position shall be automatically mapped during system turn-up
2. Frequency Bands Supported:
- a. 769 - 805 MHz LMR
  - b. 806 - 870 MHz LMR/SMR/ESMR
3. Approved Manufacturer: Andrew ION-B, ION-M or equivalent, in accordance with “Alternates” section of this specification.
- M. Fiber-Optic Remote Units: The Fiber-Optic Remote Unit converts the RoF signal back to radio over coax, as well as provides filtering so that multiple frequency bands can reside over the same passive cable and antenna infrastructure.
1. Characteristics
- a. Operating Temperature Range: +5 °C to +40 °C
  - b. Impedence: 50 Ω
  - c. Power Consumption: ≤ 105 watts, maximum
  - d. Output Power per Carrier at Antenna Port:

Technology/Band (MHz)	Single carrier (dBm)
Analog 700	27
GSM 700	27
Analog 800 and 850	27
GSM 850 and 850	31
GSM 850 and 850 at band edges	29
iDEN 800 and 850	26
iDEN 800 and 850 at band edges	24
CDMA 800 and 850	29
CDMA 800 and 850 at band edges	27
Analog 900	29
iDEN 900	23
CDMA 1700	30
W-CDMA 1700	28
Analog 1900	31

GSM 1900	31
CDMA 1900	29
W-CDMA 1900	27

- e. MTBF (excluding external power supply):  $\geq 160,000$  hours
- f. Physical: The Remote Unit shall consist of the following:
  - 1) Ingress Protection: IP31 or equivalent
  - 2) Frequency Bands supported:
    - a) 769 - 805 MHz LMR
    - b) 806 - 870 MHz LMR/SMR/ESMR
  - 3) Optical Port: 2xSC-APC connector (separated uplink/downlink)
  - 4) Antenna Port: Single 50  $\Omega$  N type female connector
  - 5) Auxiliary Ports: Two SMA female for future add-on modules

g. Uplink Noise Figure:

- 1) LMR 700, LMR 800:  $\leq 7.5$  dB

2. Approved Manufacturer: Andrew ION-B, ION-M Series or equivalent in accordance with “Alternates” section of this specification.

N. Uninterruptible Power Supply (UPS):

- 1. Suitable for mounting in standard EIA 19-inch equipment frame.
- 2. Provide unit with sufficient capacity to supply power to the entire BDA/DAS system continuously for a minimum of 12 hours in the event that normal power is unavailable.

O. At a minimum, the following spare components shall be provided to the Owner:

- 1. If the total quantity of coverage antennas exceeds 20, contractor shall provide a minimum of 5% spare antennas for each antenna type provided for project. A minimum of 1 antenna for each type shall be provided.
- 2. If the DAS is of a type utilizing active components, such as a fiber optic DAS, then the contractor shall provide a minimum of 10% spares for each type of active component utilized in the system. This requirement excludes active components located at the head-end.
- 3. Provide one spare uninterruptible power supply identical in electrical characteristics to the one provided for BDA/DAS standby power.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. The contractor shall design, install, commission and test the DAS in accordance with the manufacturer's instructions and recommendations.
- B. The contractor shall install the DAS in accordance with the accepted SOW.

#### 3.2 ACCEPTANCE TESTING

- A. The contractor shall complete all configuration and optimization tasks prior to final acceptance testing.
- B. Perform acceptance testing confirming that system performance requirements are in accordance with "Performance Requirements" section of this specification.
- C. The contractor shall complete the acceptance testing as prescribed in the approved Acceptance Test Plan (ATP) submittal.

END OF SECTION 275319

## SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Addressable fire-alarm system.
  - 2. Fire-alarm control unit (FACU).
  - 3. Manual fire-alarm boxes.
  - 4. System smoke detectors.
  - 5. Heat detectors.
  - 6. Fire-alarm notification appliances
  - 7. Fire-alarm addressable interface devices.
  - 8. Digital alarm communicator transmitters (DACTs).

#### 1.3 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
- E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- F. NICET: National Institute for Certification in Engineering Technologies.
- G. PC: Personal computer.
- H. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

#### 1.4 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by Engineer-of-Record, who is the Authority Having Jurisdiction for purposes of shop drawing review, construction observation and signing of NFPA 72 Record of Completion form.
- B. Product Data: For each type of product, including furnished options and accessories.
  1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
  1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
  2. Include plans, elevations, sections, and details, including details of attachments to other Work.
  3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  4. Detail assembly and support requirements.
  5. Include voltage drop calculations for notification-appliance circuits.
  6. Include battery-size calculations.
  7. Include input/output matrix.
  8. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
  9. Include performance parameters and installation details for each detector.
  10. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Qualification Statements: For Installer.
- C. Sample Warranty: Submittal must include line-item pricing for replacement parts and labor.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
    - d. Riser diagram.
    - e. Device addresses.
    - f. Record copy of site-specific software.
    - g. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      - 1) Equipment tested.
      - 2) Frequency of testing of installed components.
      - 3) Frequency of inspection of installed components.
      - 4) Requirements and recommendations related to results of maintenance.
      - 5) Manufacturer's user training manuals.
    - h. Manufacturer's required maintenance related to system warranty requirements.
    - i. Abbreviated operating instructions for mounting at FACU and each annunciator unit.
- B. Software and Firmware Operational Documentation:
1. Software operating and upgrade manuals.
  2. Program Software Backup: On USB media.
  3. Device address list.
  4. Printout of software application and graphic screens.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Smoke Detectors: Quantity equal to six percent of amount of each type installed, but no fewer than one unit of each type.
  2. Heat Detectors: Quantity equal to six percent of amount of each type installed, but no fewer than one unit of each type.

3. Detector Bases: Quantity equal to six percent of amount of each type installed, but no fewer than one unit of each type.
4. Manual Fire Alarm Boxes: Quantity equal to two percent of amount installed, but no fewer than one unit of each type.
5. Monitor, Control and Isolation Modules or Relays: Quantity equal to four percent of each type installed, but no fewer than one unit of each type.
6. Keys and Tools: One extra set for access to locked or tamperproofed components.
7. Audible and Visual Notification Appliances: Quantity equal to four percent of each type installed, but no fewer than one unit of each type installed.
8. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

## 1.8 QUALITY ASSURANCE

### A. Installer Qualifications:

1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
2. Licensed or certified by authorities having jurisdiction.

## 1.9 WARRANTY

### A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Final Completion.

## PART 2 - PRODUCTS

### 2.1 ADDRESSABLE FIRE-ALARM SYSTEM

#### A. Description:

1. Noncoded, addressable system, with horn-and-strobe notification for evacuation.

#### B. Performance Criteria:

##### 1. Regulatory Requirements:

- a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.

##### 2. General Characteristics:



- a. Automatic sensitivity control of certain smoke detectors.
- b. Fire-alarm signal initiation must be by one or more of the following devices and systems:
  - 1) Manual stations.
  - 2) Heat detectors.
  - 3) Smoke detectors.
  - 4) Automatic sprinkler system water flow.
- c. Fire-alarm signal must initiate the following actions:
  - 1) Continuously operate alarm notification appliances.
  - 2) Identify alarm and specific initiating device at FACU and remote annunciators.
  - 3) Transmit alarm signal to remote alarm receiving station.
  - 4) Recall elevators to primary or alternate recall floors (by smoke detectors in the elevator pit and at elevator landings only).
  - 5) Activate elevator power shunt trip (by heat detectors at the elevator pit and second floor elevator landing only).
  - 6) Record events in system memory.
- d. Supervisory signal initiation must be by one or more of the following devices and actions:
  - 1) Valve supervisory switch.
  - 2) Elevator shunt-trip supervision.
  - 3) Loss of power to or trouble conditions associated with sprinkler piping heat trace controller.
- e. System trouble signal initiation must be by one or more of the following devices and actions:
  - 1) Open circuits, shorts, and grounds in designated circuits.
  - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  - 4) Loss of primary power at FACU.
  - 5) Ground or single break in internal circuits of FACU.
  - 6) Abnormal ac voltage at FACU.
  - 7) Break in standby battery circuitry.
  - 8) Failure of battery charging.
  - 9) Abnormal position of switch at FACU or annunciator.
- f. System Supervisory Signal Actions:
  - 1) Identify specific device initiating event at FACU.
  - 2) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.

g. Document Storage Box:

- 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
- 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
- 3) Color: Red powder-coat epoxy finish.
- 4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
- 5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.
- 6) Location: Place adjacent to Fire Alarm Control Unit.

2.2 FIRE-ALARM CONTROL UNIT (FACU)

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. Bosch Security Systems, Inc.
2. Edwards, A Carrier Company.
3. Fire-Lite Alarms; Honeywell International, Inc.
4. Gamewell-FCI; Honeywell International, Inc.
5. Notifier; Honeywell International, Inc.
6. Silent Knight; Honeywell International, Inc.
7. Simplex; brand of Johnson Controls International plc, Building Solutions North America.

B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.

C. Performance Criteria:

1. Regulatory Requirements: Comply with NFPA 72 and UL 864.
2. General Characteristics:
  - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
  - b. Include real-time clock for time annotation of events on event recorder.
  - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
  - d. FACU must be listed for connection to central-station signaling system service.
  - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.

- f. Addressable Initiation Device Circuits: FACU must indicate which communication zones have been silenced and must provide selective silencing of alarm notification appliance by building communication zone.
  - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
- g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
  - 1) Annunciator and Display: LCD, 80 characters, minimum.
  - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
  - 1) Annunciator and Display: LCD, two lines of 40 characters, minimum.
  - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.
- i. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
  - 1) Pathway Class Designations: NFPA 72, Class A for Signaling-Line Circuit and Class B for Initiating-Device and Notification-Appliance Circuits.
  - 2) Pathway Survivability: Level 1.
  - 3) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative. There must be no more than twenty devices between isolator modules.
  - 4) System shall be provided with a minimum of one Signaling-Line Circuit with a minimum capacity of 99 analog detectors and 99 monitor or control modules. The system shall also be capable of expansion to a minimum of 1980 devices.
- j. Serial Interfaces:
  - 1) One dedicated RS 485 port for central-station operation using point ID DACT.
  - 2) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
  - 3) One USB port for PC configuration.
- k. Smoke-Alarm Verification:

- 1) Initiate audible and visible indication of "alarm-verification" signal at FACU.
- 2) Activate approved "alarm-verification" sequence at FACU and detector.
- 3) Sound general alarm if alarm is verified.
- 4) Cancel FACU indication and system reset if alarm is not verified.

l. Notification-Appliance Circuit:

- 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
- 2) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.

m. Elevator Recall: Initiate by one of the following alarm-initiating devices:

- 1) Elevator lobby smoke detectors.
- 2) Smoke detector in elevator pit.

n. Elevator controller must be programmed to move car to alternate recall floor if lobby detectors located on designated recall floors are activated.

o. Heat detectors in elevator pit and second floor elevator lobby must shut down elevator without time delay.

p. Remote Smoke-Detector Sensitivity Adjustment: Controls must select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

q. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.

r. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals DACT] must be powered by 24 V(dc) source.

s. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.

t. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.

u. Batteries: Sealed gel cell type, sized for 60 hours of supervisory and 5 minutes of alarm time.

D. Accessories:

1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.

## 2.3 MANUAL FIRE-ALARM BOXES

- 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. Bosch Security Systems, Inc.
  2. Edwards, A Carrier Company.
  3. Fire-Lite Alarms; Honeywell International, Inc.
  4. Gamewell-FCI; Honeywell International, Inc.
  5. Notifier; Honeywell International, Inc.
  6. Silent Knight; Honeywell International, Inc.
  7. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
- B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
  1. Double-action mechanism requiring two actions to initiate alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
  2. Station Reset: Key-operated switch.
  3. Able to perform at up to **90** percent relative humidity at 90 deg F.
  4. Material: Manual stations made of Lexan polycarbonate.
  5. Able to be used in indoor areas.

## 2.4 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:
  1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    - a. Bosch Security Systems, Inc.
    - b. Edwards, A Carrier Company.
    - c. Fire-Lite Alarms; Honeywell International, Inc.
    - d. Gamewell-FCI; Honeywell International, Inc.
    - e. Notifier; Honeywell International, Inc.
    - f. Silent Knight; Honeywell International, Inc.
    - g. Simplex; brand of Johnson Controls International plc, Building Solutions North America.

2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 268.

b. General Characteristics:

- 1) Detectors must be two-wire type.
- 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring. Pigtails are not acceptable.
- 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
  - a) Primary status.
  - b) Device type.
  - c) Present average value.
  - d) Present sensitivity selected.
  - e) Sensor range (normal, dirty, etc.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White.
- 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 11) Multiple levels of detection sensitivity for each sensor.
- 12) Sensitivity levels based on time of day.

2.5 HEAT DETECTORS

A. Fixed-Temperature-Type Heat Detectors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Bosch Security Systems, Inc.
- b. Edwards, A Carrier Company.
- c. Fire-Lite Alarms; Honeywell International, Inc.
- d. Gamewell-FCI; Honeywell International, Inc.
- e. Notifier; Honeywell International, Inc.
- f. Silent Knight; Honeywell International, Inc.
- g. Simplex; brand of Johnson Controls International plc, Building Solutions North America.

2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 521.

b. General Characteristics:

- 1) Actuated by temperature that exceeds fixed temperature of 135 deg F.
- 2) Mounting: Twist-lock base interchangeable with smoke-detector bases.
- 3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 4) Detector must have functional humidity range of 10 to 90 percent.

2.6 Color: White. FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - a. Cooper Wheelock; brand of Eaton.
  - b. Edwards, A Carrier Company.
  - c. Gamewell-FCI; Honeywell International, Inc.
  - d. Notifier; Honeywell International, Inc.
  - e. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
- 2. Description: Horns, bells, or other notification devices that cannot output voice messages.
- 3. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
  - b. General Characteristics:
    - 1) Audible notification appliances must have functional humidity range of 10 to 93 percent relative humidity.

- 2) ISO Temporal 3 Evacuation Tone: 90 plus or minus 4 dB(A-weighted) at 24 V.
- 3) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
- 4) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

**B. Fire-Alarm Visible Notification Appliances:**

1. 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. Cooper Wheelock; brand of Eaton.
  - b. Edwards, A Carrier Company.
  - c. Gamewell-FCI; Honeywell International, Inc.
  - d. Notifier; Honeywell International, Inc.
  - e. Simplex; brand of Johnson Controls International plc, Building Solutions North America.
2. Performance Criteria:
  - a. Regulatory Requirements:
    - 1) NFPA 72.
    - 2) UL 1971.
  - b. General Characteristics:
    - 1) Rated Light Output:
      - a) 15/30/75/110 cd, selectable in field.
    - 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
    - 3) Mounting: Wall mounted unless otherwise indicated.
    - 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
    - 5) Flashing must be in temporal pattern, synchronized with other units.
    - 6) Strobe Leads: Factory connected to screw terminals.
    - 7) Mounting Faceplate: Factory finished, white.

**2.7 FIRE-ALARM REMOTE ANNUNCIATORS**

- 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. Bosch Security Systems, Inc.
2. Edwards, a Carrier Company.
3. Gamewell-FCI; Honeywell International, Inc.
4. Simplex; brand of Johnson Controls International plc, Building Solutions North America.

B. Performance Criteria:

1. Regulatory Requirements:
  - a. NFPA 72.
2. General Characteristics:
  - a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
    - 1) Mounting: Flush cabinet, NEMA 250, Type 1.
  - b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.8 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

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. Bosch Security Systems, Inc.
2. Edwards, A Carrier Company
3. Fire-Lite Alarms, Honeywell International, Inc.
4. Gamewell-FCI; Honeywell International, Inc.
5. Notifier; Honeywell International, Inc.
6. Silent Knight
7. Simplex, brand of Johnson Controls International plc, Building Solutions North America

B. Performance Criteria:

1. Regulatory Requirements:
  - a. NFPA 72.
2. General Characteristics:
  - a. Include address-setting means on module.
  - b. Store internal identifying code for control panel use to identify module type.
  - c. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.

- d. Integral Relay: Capable of providing direct signal to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.
  - 1) Allow control panel to switch relay contacts on command.
  - 2) Have minimum of two normally open and two normally closed contacts available for field wiring.

## 2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

- 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. Bosch Security Systems, Inc.
- 2. Edwards, A Carrier Company.
- 3. Gamewell-FCI; Honeywell International, Inc.
- 4. Simplex, brand of Johnson Controls International plc, Building Solutions North America

- B. Performance Criteria:

- 1. Regulatory Requirements:
  - a. NFPA 72.
- 2. General Characteristics:
  - a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
  - b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture two telephone line(s) and dial preset number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.
  - c. Local functions and display at DACT must include the following:
    - 1) Verification that both telephone lines are available.
    - 2) Programming device.
    - 3) LED display.
    - 4) Manual test report function and manual transmission clear indication.
    - 5) Communications failure with central station or FACU.
  - d. Digital data transmission must include the following:
    - 1) Address of alarm-initiating device.
    - 2) Address of supervisory signal.

- 3) Address of trouble-initiating device.
- 4) Loss of ac supply.
- 5) Loss of power.
- 6) Low battery.
- 7) Abnormal test signal.
- e. Secondary Power: Integral rechargeable battery and automatic charger.
- f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

#### 3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices placed in service before other trades have completed cleanup must be replaced.
  - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
2. Mount manual fire-alarm box on background of contrasting color.
3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level.

C. Smoke- and Heat-Detector Spacing:

1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
  2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
  3. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
  4. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
  5. Lighting Fixtures: Locate detectors not closer than 12 inches from lighting fixture and not directly above pendant mounted or indirect lighting.
- D. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- E. Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- F. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- G. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." All wiring shall be color coded and AWG 14 minimum, stranded copper, THHN/THWN.
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

### 3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

### 3.6 PATHWAYS

- A. Pathways must be installed in EMT, or other material if required for the location, such as liquid-tight, IMC, RMC, etc.

### 3.7 CONNECTIONS

- A. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
  1. Alarm-initiating connection to elevator recall system and components.
  2. Supervisory connections at valve supervisory switches.
  3. Supervisory connections at elevator shunt-trip breaker.
  4. Supervisory connections at sprinkler piping heat trace controller.

### 3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in location visible from FACU.

### 3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

### 3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by Architect and authorities having jurisdiction.
- B. Administrant for Tests and Inspections:
  - 1. Administer and perform tests and inspections with assistance of factory-authorized service representative.
- C. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
    - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
  - 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
  - 3. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
  - 4. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Final Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.11 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Allow Owner to record training.

3.12 MAINTENANCE

- A. Maintenance Service: Beginning at Final Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
  - 1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - 3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.13 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Final Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Final Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Final Completion. Upgrading software must include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11





## SECTION 311000 - SITE CLEARING

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to perform and complete clearing site of incidental paving and curbs, debris, grass, trees, and other plant life in accordance with the plans. All materials and procedures shall be of the type specified herein.

##### B. Section Includes:

1. Removing surface debris.
2. Removing designated paving, curbs, and other above- and below-grade site improvements.
3. Removing designated trees, shrubs, and other plant life.
4. Removing abandoned utilities.
5. Protecting existing vegetation to remain.
6. Excavating and stockpiling topsoil.

#### 1.02. SUBMITTALS

##### A. Section 01 30 00 - Submittals/Electronic Submittals.

##### B. Product Data: Submit data for herbicide and tree wound paint. Indicate compliance with applicable codes for environmental protection.

##### C. Existing Conditions: Submit documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

##### D. Record Drawings: Identify and accurately show locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

#### 1.03. DEFINITIONS

##### A. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

##### B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

##### C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil. Includes the zone where plant roots grow.

- D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, as indicated on Drawings, or as designated by the ENGINEER.
  - E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.
- 1.04. QUALITY ASSURANCE
- A. Conform to applicable codes for environmental requirements, disposal of debris, burning debris on site, and use of herbicides.
  - B. Perform all work and provide materials in accordance with the requirements of federal, state, and local authorities having jurisdiction.
    - 1. Comply with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on CONTRACTOR's licensing, certification and record keeping. Contact the command Pest Control Coordinator prior to starting work.

## PART 2 PRODUCTS

### 2.01. MATERIALS

- A. Herbicide: Approved by authority having jurisdiction.
- B. Tree wound paint: Bituminous based paint of standard manufacture specially formulated for tree wounds.
- C. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb./ft. remaining flexible from -60° to +200° F inert to most chemicals and acids; minimum tensile yield strength of 2,000 psi and ultimate tensile strength of 2,680 psi secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet apart.
  - a. Height: 4 feet.
  - b. Color: High-visibility orange, nonfading.

## PART 3 EXECUTION

### 3.01. EXAMINATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Wrap a 1-inch blue vinyl tie tape flag around each tree trunk at 54 inches above the ground.
- B. Identify waste area and salvage area for placing removed materials.
- C. Work on adjoining property will be not permitted without the written consent of the property OWNER and the ENGINEER. This includes, but is not limited to, temporary access to the Work, storage of materials, and any ground disturbing activities.

### 3.02. PREPARATION

- A. Call **NC 811** utility locating service not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.
  - B. The ENGINEER will designate all areas of growth or individual trees which are to be preserved due to their desirability for landscape or erosion control purposes.
  - C. Do not commence site clearing operations until temporary erosion and sedimentation control and plant/tree protection measures are in place as specified.
  - D. Carefully remove items indicated to be salvaged.
    1. Disassemble and/or remove indicated items as necessary to permit construction, and safely store items on OWNER's premises to prevent harm to the materials.
    2. Following construction, reassemble in the original location (or other onsite area designated by OWNER) in a manner that matches the assembly prior to its removal. If the salvaged item(s) are to be utilized by the OWNER offsite, the CONTRACTOR shall disassemble and store the items and coordinate with OWNER regarding the OWNER's transportation and reuse of these materials offsite.
  - E. 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. Keep roads and walks free of dirt and debris at all times unless otherwise permitted by OWNER or authorities having jurisdiction. When permitted, dirt and debris shall be cleaned, swept, and removed at the end of each workday.
    3. Provide alternate routes around closed or obstructed traffic ways if required by OWNER or authorities having jurisdiction.
- 3.03. PROTECTION
- A. Locate, identify, and protect utilities indicated to remain, from damage.
    1. Notify the ENGINEER immediately of damage to or an encounter with an unknown existing utility line. Repair damage to existing utility lines that are indicated or made known to the CONTRACTOR prior to start of clearing and grubbing operations at no additional cost to the OWNER.
  - B. Do not interrupt utilities serving facilities occupied by OWNER or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
    1. Notify ENGINEER not less than three (3) days in advance of proposed utility interruptions.
    2. Do not proceed with utility interruptions without ENGINEER's written permission.
  - C. Protect trees, plant growth (including root structure), and features designated to remain, as final landscaping.
    1. Trim all branches of trees to remain to such heights and in such manner as may be necessary to prevent interference with construction operations. Cut smoothly and

neatly close to the whole of the tree or to main branches without splitting or crushing.  
Paint the cuts with an approved tree wound paint.

2. Encircle the drip line of trees or groups of trees which are to remain adjacent to the work with plastic protection-zone fencing as may be necessary to protect them from piled material, equipment, or equipment operation.
  3. Chip removed tree branches and stockpile in approved areas, if approved by ENGINEER, or dispose of off-site.
  4. Protect all cultivated hedges, shrubs, and plants that might be injured by project operations. Promptly heel in any trees or shrubbery necessary to be removed and replanted. Perform heeling in and replanting under the direction of a licensed and experienced nurseryman. Replant in their original position all removed shrubbery and trees after construction operations have been substantially completed and care for until growth is reestablished.
- D. Remove trees, cultivated hedges, shrubs, plants, and other landscape features injured by equipment operations to such a degree as to affect their growth or diminish their beauty or usefulness, and replace with equivalent, undamaged trees and landscape features.
1. Obtain ENGINEER's approval before replacement.
- E. Protect benchmarks, survey control points, and existing structures from damage or displacement.
- F. Protect existing site improvements to remain from damage during construction.
1. Restore damaged improvements to their original condition, as acceptable to OWNER.
- G. The following practices are prohibited within plant protection zones:
1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Foot traffic.
  4. Erection of sheds or structures.
  5. Impoundment of water.
  6. Excavation or other digging unless otherwise indicated.
  7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
  8. Heat sources, flames, ignition sources, and smoking.
- H. Do not direct vehicle or equipment exhaust towards protection zones.

#### 3.04. CLEARING

- A. Clearing consists of the felling and cutting up, or the trimming of trees and the satisfactory disposal of the trees and other vegetation together with the down timber, snags, brush, and rubbish occurring within the areas to be cleared. Trees and other vegetation, except such individual trees, groups of trees, and vegetation, as indicated on the plans to be left standing, shall be cut off flush with or below the original ground surface trees, stumps, roots, brush, and other vegetation in areas to be cleared.

- B. Perform clearing only within the limits established by the plans, specifications, or the ENGINEER.
  - C. Prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction. When such damages occur, repair, remove, or otherwise resolve all damaged areas, utilizing generally accepted practices at no additional cost to the OWNER.
  - D. Remove trees and shrubs within marked areas and where indicated. Remove stumps, main root ball, root system, logs, organic and metallic debris, brush, and refuse to depth of not less than 18 inches below the original soil surface in areas indicated to be grubbed and in areas indicated as construction areas under this contract.
    - 1. Use only hand methods for grubbing within protection zones.
    - 2. In embankment areas, when the depth of embankment exceeds 42 inches in height, sound stumps shall be cut off not more than 6 inches above the existing ground level and not grubbed. Unsound or decayed stumps shall be removed to a depth of approximately 2 feet below the natural ground surface.
    - 3. Fill depressions made by grubbing with suitable material and compact as specified to make the new surface conform with the existing adjacent surface of the ground.
  - E. Clear undergrowth and deadwood, without disturbing subsoil.
  - F. Apply herbicide in accordance with the manufacturer's label to remaining stumps to inhibit growth.
- 3.05. REMOVAL
- A. Remove debris, rock, demolished materials, extracted plant life, and waste materials, and legally dispose of them off site.
  - B. Remove paving, curbs, slabs, gutters and, aggregate base as indicated on Drawings.
    - 1. Unless existing, full-depth joints coincide with line of demolition, neatly saw-cut along the line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
    - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.
  - C. Remove abandoned utilities. Indicated removal termination point for underground utilities on Record Documents.
  - D. 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.
  - E. Consider felled timber from which saw logs, pulpwood, posts, poles, ties, or fuelwood can be produced as saleable timber. Trim limbs and tops, and saw into saleable lengths for saw logs, pulpwood, poles, ties, and for fuelwood and stockpile in designated salvage area. Timber, steel and other merchantable goods and materials removed incidental to clearing and grubbing shall remain the property of individual property owners unless otherwise

directed. CONTRACTOR shall coordinate clearing activities or removal of any unwanted debris with property owner during the course of the project.

- F. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- G. Burn or bury materials on site only when permitted by the ENGINEER. Leave site in clean condition.
  - 1. Deposit all combustible matter at locations approved by authorities having jurisdiction. Combustible matter may be burned (with written approval of Fire Marshall or other authorities having jurisdiction) or disposed of as stated above. Adhere to all limitations and conditions set forth in the permit.
  - 2. Burning shall be done at such time and in such a manner as to prevent fire from spreading and to prevent any damage to adjacent cover and shall further be subject to all requirements of agencies having jurisdiction pertaining to the burning. Keep burning under constant attendance until all fires have burned out or have been extinguished.

### 3.06. TOPSOIL EXCAVATION

- A. Remove sod and grass before stripping topsoil.
- B. Excavate topsoil to a depth of 6 inches from areas to be further excavated, relandscaped, or regraded, without mixing with foreign materials for use in finish grading.
  - 1. Remove subsoil and non-soil materials, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Do not excavate wet topsoil. Handle topsoil only when the topsoil is dry or slightly moist.
- D. Stockpile topsoil without intermixing with subsoil in area designated on site to depth not exceeding 6 feet and protect from erosion.
  - 1. Stockpile surplus topsoil to allow for resspreading deeper topsoil.
  - 2. Grade and shape stockpiles to drain surface water
  - 3. Do not stockpile topsoil within protection zones.
  - 4. Cover to prevent windblown dust and erosion by water.
  - 5. Stockpile material until disposal.
- E. Remove excess topsoil not intended for reuse and unsuitable topsoil from site.

END OF SECTION 311000

## SECTION 311505 - EXCAVATION, BACKFILL, AND COMPACTION

### PART 1 GENERAL

#### 1.01. THE REQUIREMENT

- A. Furnish all labor, materials, equipment, and incidentals necessary to perform all excavation, backfill, compaction, and grading required completing the work shown on the Drawings and specified herein.
- B. The work shall include, but not necessarily be limited to excavation, backfilling, grading, compaction, disposal of waste and surplus materials, placing crushed stone, construction of berms, and all related work such as sheeting, bracing, and dewatering.
  - 1. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA excavation safety standards 29 CFR Part 1926.650 Subpart P and State requirements.
    - a. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.
  - 2. Excavated topsoil and excess cut material will be stockpiled in locations approved by the ENGINEER.

#### 1.02. REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the Specifications, all work herein shall conform to the applicable requirements of the following documents.
  - 1. North Carolina Department of Transportation Standard Specifications for Roads and Structures.
  - 2. ASTM C 127 - Test for Specific Gravity and Absorption of Coarse Aggregate
  - 3. ASTM C 136 -Test for Sieve Analysis of Fine and Coarse Aggregates
  - 4. ASTM D 422 - Particle Size Analysis of Soils
  - 5. ASTM D 423 - Test for Liquid Limit of Soils
  - 6. ASTM D 424 - Test for Plastic Limit and Plasticity Index of Soils
  - 7. ASTM C 535 - Test for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  - 8. ASTM D 698 - Standard Method of Test for the Moisture - Density Relations of Soils Using a 5.5 lb. (2.5 kg) Rammer and a 12-inch (305 mm) Drop
  - 9. ASTM D1556 - Test for Density of Soil in Place by the Sand-Cone Method
  - 10. ASTM D1557 - Test for Moisture-Density Relations of Soils and Soil Aggregate Mixtures Using 10-lbs. (4.5 kg) Rammer and 18-inch (457 mm) Drop
  - 11. ASTM D2049 - Test Method for Relative Density of Cohesionless Soils
  - 12. ASTM D2167 - Test for Density of Soil in Place by the Rubber-Balloon Method
  - 13. ASTM D2216 - Test for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil Aggregate Mixtures

14. ASTM D2487 - Test for Classification of Soils for Engineering Purposes

15. ASTM D2922 - Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1.03. SUBMITTALS

- A. Excavation support designs shall be prepared by a licensed professional engineer, registered in the State of North Carolina, having a minimum of five years of professional experience in the design and construction of excavation support systems.
- B. Submit a sealed copy of the required Engineering Certification Form in accordance with Section 01 30 00 - Submittals prior to beginning work.

1.04. QUALITY ASSURANCE

A. Codes and Standards

- 1. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.

B. Testing and Inspection Services

- 1. Provide access for testing agency to perform soil testing and inspection services for quality control during earthwork operations.
- 2. A testing laboratory approved by the ENGINEER will be employed by the CONTRACTOR and paid by the CONTRACTOR. If included in the PROJECT BID SCHEDULE these costs shall be reimbursable from the Bid Allowance line item established for testing; otherwise, these costs should be included in the price of the work to be completed.
- 3. Allow testing agency to inspect and approve subgrades and fill layers before construction work is performed.

C. Compaction Testing

- 1. The testing agency shall be NCDOT certified.
- 2. Tests will be performed in accordance with applicable NC DOT, ASTM, or AASHTO standard methods, unless otherwise specified.
  - a. The optimum moisture content and the maximum density of each type of material used for structural fill and backfill will be determined in accordance with ASTM D698 or AASHTO T-99.
  - b. The field moisture content of materials being compacted will be determined by ASTM D2216 - Laboratory Determination of Moisture Content of Soil.
  - c. The field density of compacted material will be determined by ASTM D1556 - Test for Density of Soil in Place by the Sand-Cone Method, or by other acceptable in-place density testing method.
- 3. Testing Frequency
  - a. Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. Frequency and location will be chosen by ENGINEER.



- b. Fill improperly compacted shall be reopened to the depth directed, then refilled and compacted to the density specified at no additional cost to the OWNER.

1.05. JOB CONDITIONS

- A. Carefully maintain all reference points, property markers, right-of-way markers, benchmarks, etc., and accurately restore if disturbed.
- B. The presence of groundwater in the soil will not constitute a condition for which an increase in the contract price will be made.
- C. Existing Utilities
  - 1. CONTRACTOR is responsible for locating all utilities and protecting them from damage.
  - 2. Cooperate with OWNER and utility companies for maintaining services.
  - 3. Do not break utility connections without notifying utility or OWNER a minimum of 48 hours in advance and providing acceptable temporary services if required.
  - 4. Repair damage to existing utilities as directed by utility company.

PART 2 PRODUCTS

2.01. SOIL

- A. Soils for bedding and backfill are described in the ASTM D2487 Figure 1 soils classification chart, and, for purposes of these Specifications, are grouped into five (5) categories as follows, according to their suitability for this application:
  - 1. Class I Soil - Angular, 6 to 40 mm (¼" to 1½"), graded stone, including several fill materials that have regional significance, such as coral, slag, cinders, crushed stone, and crushed shells.
  - 2. Class II Soil - Coarse sands and gravels with maximum particle size of 40 mm (1½"), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW, and SP are included in this class.
  - 3. Class III Soil - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil types GM, GC, SM, and SC are included in this class.
  - 4. Class IV Soil - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH, and CL are included in this class. These materials are not recommended for bedding, haunching, or initial backfill.
  - 5. Class V Soil - Includes the organic soils - types OL, OH, and PT, as well as soils containing frozen earth, debris, rocks larger than 1½ inches in diameter, and other foreign materials. These materials are not recommended for bedding, haunching, or initial backfill for any of the accepted pipe materials.

2.02. FILL MATERIALS

- A. Materials for use as fill shall be as described below. The CONTRACTOR shall notify the ENGINEER of the source of each material.

- B. Materials shall be furnished as required from approved off-site sources and hauled to the site.
  - C. Common Fill
    - 1. Common Fill shall consist of mineral soil free from organic materials, loam, wood, trash, and other objectionable materials which may be compressible, or which cannot be properly compacted.
    - 2. Common fill shall not contain stones larger than 4 inches in largest dimension and shall have at least 60% passing the No. 4 sieve, a maximum of 60% passing the No. 200 Sieve, a maximum liquid limit of 60, and a maximum plasticity index of 25.
    - 3. Common Fill shall not contain granite blocks, broken concrete, masonry rubble, or other similar materials.
      - a. It shall have physical properties such that it can be readily spread and compacted during filling.
      - b. Snow, ice, and frozen soil will not be permitted.
  - D. Select Fill
    - 1. Select Fill shall be as specified above for Common Fill except that the material shall contain no stones larger than two inches in largest dimension, a maximum of 50% passing the No. 200 Sieve, a maximum liquid limit of 50 and a maximum plasticity index of 15.
  - E. Structural Fill
    - 1. Structural Fill shall be as specified above for Select Fill except that the material shall have a maximum liquid limit of 40% and a maximum plasticity index of 10 percent.
    - 2. Structural Fill shall be used for roadway shoulder construction as indicated on the Drawings.
  - F. The soils shall be wetted or dried as necessary so that the moisture content during compaction is within 3% of the optimum moisture content as determined by ASTM D698.
  - G. Highly micaceous and elastic silts shall not be used for Common, Select Fill, or Structural Fill.
- 2.03. STONE FOR STABILIZATION OF FOUNDATION
- A. Stone used for pipe bedding and trench stabilization shall meet the gradation requirements of standard aggregate size No. 67 as contained the Standard Specifications for Roads & Structures as published by the NC Department of Transportation, latest edition.
- 2.04. CRUSHED STONE
- A. All crushed stone shall be silica material that is sound, hard, durable, resistant to weathering, as defined by ASTM D2488 and shall be free of overburden, spoil, shale, limestone, and organic material.
  - B. The stone shall be free of deleterious materials such as flat, elongated, friable, decomposed, or micaceous pieces.
    - 1. Broken pieces of concrete, asphalt, or brick are not acceptable.

C. Crushed stone shall be of the size and type shown on the drawings.

2.05. RIP-RAP

A. Provide NCDOT, Class A, B, I or II Rip Rap as shown on the drawings.

B. Rip Rap shall comply with NCDOT Standard Specifications Section 1042 - Riprap.

PART 3 EXECUTION

3.01. GENERAL EXCAVATION

A. General excavation is expected to consist of removing unsuitable soils identified during proofrolling.

1. The bottom of the excavations shall be rendered firm and dry and, in all respects, acceptable to the ENGINEER.

B. Excavation and dewatering shall be accomplished by methods that preserve the undisturbed state of subgrade soils.

1. Soils which become soft, loose, "quick", or otherwise unsatisfactory for support of structures, earthen or man-made, as a result of inadequate excavation, dewatering, proofrolling, or other construction methods shall be removed and replaced as required by the ENGINEER at the CONTRACTOR's expense.

C. Dewatering shall lower the groundwater to at least 1-foot below excavation subgrade and prevent "boiling" condition or detrimental under-seepage at the base of the excavation as specified herein.

D. Excavation equipment shall be satisfactory for carrying out the work in accordance with the Specifications.

E. Proof-roll exposed subgrades after stripping topsoil and organics with a minimum of two complete passes of a rubber tired heavy vehicle as approved by the ENGINEER.

1. All proofrolling shall be conducted in the presence of the ENGINEER.

2. The ENGINEER may require excavation and replacement or other remediation as necessary to provide a firm, stable subgrade in areas that appear to be rutting, pumping, or otherwise appear unstable while proofrolling.

3.02. TRENCH EXCAVATION

A. Excavation for all trenches required for the installation of pipes shall be made to the depths indicated on the Drawings and in such a manner and to such widths as will give suitable room for laying the pipe within the trenches, for bracing and supporting the trench sides and for pumping and drainage facilities.

1. CONTRACTOR shall render the bottom of the excavations firm and stable and in all respects acceptable to the ENGINEER.

2. The trench may be excavated by machinery to, or just below the designated subgrade provided that the material remaining in the bottom of the trench is not disturbed.

3. Where pipe is to be installed in fill, fill shall be placed and compacted to at least 2 ft. above the top of the pipe (rough grade elevation) and then trenches re-excavated for pipe installation.

4. After the trench has been excavated as required to assure the correct invert and a space has been excavated for the pipe bells, lower the pipe into the trench.
5. The pipe shall be placed as near to the center of the trench allowing ample room for compaction on each side.

B. PVC Pipe

1. After excavation is completed, bed with 4 inches of Class I, Class II, or No. 67 stone material to bring trench bottom to grade. Excavated native material may be used if material conforms to this specification.
2. After the joint has been made backfill to spring line of pipe with Class I, Class II, or No. 67 stone material.
3. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.
4. Pipe 3' to 14' of depth
  - a. Continue Class I, Class II, or No. 67 stone material to top of pipe in 8"-12" layers and compact.
5. Pipe 14' to 20' of depth
  - a. Continue Class I, Class II, or No. 67 stone material to 6" above the top of pipe in 8"-12" layers and compact.
6. Pipe greater than 20' of depth
  - a. Continue Class I backfill to 12" above the top of pipe in 8"-12" layers and compact.
7. Backfilling to Grade
  - a. Backfill and compact from the top of embedment material to finished grade with satisfactory soil material, compacting to the density required for the area classification.
  - b. Place backfill in even 8" layers and compact to the density required for the area classification.
  - c. The finished grade shall conform to elevations, slopes, and contours as indicated on the drawings.
  - d. The CONTRACTOR shall be held responsible for settlement over all trenches, and he shall be required to add material and compact as directed if such settlements occur.

C. Ductile Iron Pipe

1. Pipe 3' to 14' of depth
  - a. After excavation and the joint has been made, bed with 4" of Class I, II, III, or IV bedding material. This may be the native trench bottom if material conforms to this specification.

- b. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.
- 2. Pipe 14' to 20' of Depth
  - a. After excavation is completed, bed with 4" of Class I, Class II, or No. 67 stone material to bring trench bottom to grade.
  - b. After the joint has been made backfill to spring line of pipe with Class I, Class II, or No. 67 stone material.
  - c. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.
- 3. Pipe greater than 20' of depth
  - a. After excavation is completed, place 6" of Class I bedding material.
  - b. After the joint has been made, backfill with 4" to 6" of Class I bedding material.
  - c. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface.
  - d. Continue Class I backfill to 6" above the top of pipe in 8"-12" layers and compact.
- 4. Backfilling to Grade
  - a. Backfill and compact from the top of embedment material to finished grade with satisfactory soil material, compacting to the density required for the area classification.
  - b. Place backfill in even 8" layers and compact to the density required for the area classification.
  - c. The finished grade shall conform to elevations, slopes, and contours as indicated on the drawings.
  - d. The CONTRACTOR shall be held responsible for settlement over all trenches, and he shall be required to add material and compact as directed if such settlements occur.

### 3.03. ROCK EXCAVATION

- A. Rock Excavation consists of blasting and removal of rock material for establishing the required subgrade elevation for pipe trenches and shall include stockpiling excavated material and subsequent placement or disposal of it.
  - 1. Trench Rock is defined as any material which cannot be practically excavated by a Caterpillar Model No. 330 hydraulic excavator, or equivalent, without the use of hoe-ramming or blasting. Practical excavation is defined as the ability to remove at least 10 cubic yards of material during one hour of continuous digging. This classification does not include material such as loose rock, concrete, or other materials that can be removed by means other than hoe-ramming or blasting, but which for reasons of

economy in excavating, the CONTRACTOR chooses to remove by hoe-ramming or blasting.

- B. Contractor shall excavate and remove rock a minimum of 4 inches below the bottom of the pipe and install appropriate bedding material as defined in these specifications.
- C. If Rock is Classified:
  - 1. It is the responsibility of the CONTRACTOR to establish the top elevation of rock by test digging with an excavator at not greater than 50-foot intervals in the presence of the ENGINEER.
  - 2. The ENGINEER shall then establish the top elevation of the rock layer and compute the quantity of material to be classified as rock, and the CONTRACTOR shall be paid accordingly.
  - 3. There shall be no payment for rock excavated if the ENGINEER has not been notified to prepare measurements and confirm quantities in advance of such excavation.

#### 3.04. BLASTING

- A. Where blasting is necessary to perform the required excavations, the number and size of the charges shall be subject to the acceptance of the ENGINEER.
  - 1. Explosives shall be of such quantity and power and used in such locations as will neither open seams nor otherwise disturb the rock outside the prescribed limits of excavation.
  - 2. As the excavation approaches its final limits, the depth of holes for blasting and the amount of explosives used for each hole shall be reduced so that the underlying or adjacent rock will be neither disturbed nor shattered.
  - 3. No blasting shall be permitted within 50-feet of any existing structure.
  - 4. The CONTRACTOR shall monitor the blasting operations as necessary to ensure that the work is conducted safely and without causing excessive air or ground pressures or displacements.
    - a. This shall include measuring air and ground pressure by the use of two (2) seismographs.
    - b. When blasting, the acceptable level of vibration shall be no higher than 2 inches per second at any structure.
    - c. In residential and commercial areas, one seismograph shall be located near the closest existing structure on the same side of the street as the blast, while the second seismograph shall be located near the closest existing residential structure on the opposite side of the street.
  - 5. A blasting permit shall be obtained from the proper authorities.
  - 6. Permit shall be obtained not less than 24-hours prior to transporting any explosive material or blasting agent.
  - 7. The Fire Department may fix the hours of blasting.
  - 8. Galvanometer shall be employed to check cap circuits.

9. CONTRACTOR shall maintain a blasting log for each and every shot containing not less than the following minimum information:
  - a. Date of shot
  - b. Time of shot
  - c. Crew Supervisor
  - d. Number and depth of holes
  - e. Approximate depth of overburden
  - f. Amount and type of explosive used in each hole
  - g. Type of caps used, i.e., instant or delay
  - h. Weather conditions

10. CONTRACTOR shall furnish ENGINEER with a copy of each blasting log.

3.05. MISCELLANEOUS EXCAVATION

- A. The CONTRACTOR shall perform all excavations necessary for the placing of seeding and plants, for constructing roadways, and any other miscellaneous earth excavation required under this Contract.

3.06. PROTECTION

- A. Sheeting and Bracing (if required)
  1. Furnish, put in place, and maintain such sheeting and bracing as may be required by Federal, State, and local safety requirements to support the sides of excavations; to prevent any movement which could in any way diminish the width of the excavation below that necessary for proper construction; and to protect adjacent structures from undermining or other damage.
  2. If the ENGINEER is of the opinion that at any location sufficient or proper supports have not been provided, he/she may order additional supports put in, and compliance with such order shall not relieve or release the CONTRACTOR from his/her responsibility for the sufficiency of such supports.
  3. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled and rammed.
  4. Where soil cannot be properly compacted to fill a void, lean concrete shall be used as backfill.
  5. All voids shall be filled to the satisfaction of the ENGINEER. Sheeting and Bracing shall be installed and maintained in accordance with latest OSHA requirements and regulations.
  6. Construct the sheeting outside the neat lines of the foundation, unless indicated otherwise, to the extent deemed desirable for the method of operation.
  7. Sheeting shall be plumb and securely braced and tied in position.
  8. Sheeting and bracing shall be adequate to withstand all pressures to which the structure or trench will be subjected.

9. Any movement or bulging that may occur shall be corrected to provide the necessary clearances and dimensions.
10. All sheeting and bracing shall be carefully removed in such manner as not to endanger the construction or other structures, utilities, or property.
11. All voids left or caused by withdrawal of sheeting shall be immediately refilled with sand, which must be approved by the ENGINEER, by ramming with tools especially adapted to that purpose, or otherwise as may be directed.
12. The right of the ENGINEER to order sheeting and bracing left in place shall not be construed as creating any obligation on his/her part to issue such orders and his/her failure to exercise his/her right to do so shall not relieve the CONTRACTOR from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the CONTRACTOR to leave in place sufficient sheeting and bracing to prevent any caving or moving of the ground.
13. No sheeting is to be withdrawn if driven below mid-diameter of any pipe and under no circumstances shall any sheeting be cut off at a level lower than 1-ft above the top of any pipe.

**B. Drainage and Dewatering**

1. At all times during construction provide and maintain proper equipment and facilities to remove all water entering excavations and keep such excavations dry so as to obtain a satisfactory undisturbed subgrade condition until the fills, structures or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water into the excavated areas.
  - a. Groundwater shall be lowered to at least 1-foot below the bottom of excavations.
2. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
  - a. Well or sump installations shall be constructed with proper sand filters to prevent drawing of finer grained soil from the surrounding ground.
3. Surface runoff shall be collected, drained to sumps, and pumped from the disposal unit to maintain an excavation bottom free from standing water.
4. Take all additional precautions to prevent uplift of any structure during construction.
5. Drainage shall be disposed of so that flow or seepage back into the excavated area will be prevented.
6. Flotation shall be prevented by maintaining a positive and continuous operation of the dewatering system. The CONTRACTOR shall be fully responsible and liable for all damages which may result from failure of this system.
7. Remove the dewatering equipment after the system is no longer required.
8. Take all necessary precautions to preclude the accidental discharge of fuel, oil, etc. in order to prevent adverse effects on groundwater or surface water quality.

**C. Slope Stability**



1. The CONTRACTOR shall be solely responsible for the stability of embankments, unbalanced fills, stockpiles, and all other construction operations.

3.07. GENERAL BACKFILL

- A. Materials placed in fill areas shall be placed to the lines and grades shown on the Drawings.
  1. Unless otherwise specified, Common Fill shall be used for backfilling.
- B. Fill shall be placed in accordance with the Contract Document.
- C. Material conforming to the requirements of Common Fill shall be placed in layers having a maximum compacted thickness of 8-inches measured before compaction and shall be compacted to at least 95% of its maximum density.
- D. Select Fill shall be used where specified. Select Fill shall be placed in layers having a maximum compacted thickness of 8-inches measured before compaction and shall be compacted to at least 98% of the maximum density.
- E. Structural Fill shall be used where specified and shown on the Drawings.
  1. Structural fill shall be placed in maximum compacted lift thickness of 6 inches and shall be compacted to at least 100% of its maximum density.
- F. The surfaces of filled areas shall be graded to smooth true lines, conforming to grades indicated on the grading plan and no soft spots or uncompacted areas will be allowed in the work.
- G. No compacting shall be done when the material is covered with frost or is frozen or is too wet either from rain or from excess application of water.
  1. At such times, work shall be suspended until the previously placed and new materials have thawed and/or dried sufficiently to permit proper compaction.
- H. All backfill shall be placed at a moisture content within 3% of Standard Proctor (ASTM D698) optimum moisture content

3.08. COMPACTION

- A. General
  1. Control soil compaction during construction providing minimum percentage of density specified for each area classification.
- B. Percentage of Maximum Density Requirements
  1. Compact soil to not less than the following percentages of maximum dry density for soils which exhibit a well-defined moisture density relationship determined in accordance with these specifications.
    - a. Structures
      - 1) Compact top 12" of subgrade and each layer of backfill or fill material at 95% maximum dry density.
    - b. Pipes and Related Structures
      - 1) Pipe bedding and embedment material to 90% maximum dry density.

- 2) Backfill and compact trenches in uniform layers from top of bedding and embedment material to finish grade to 95% maximum dry density.
- c. Unpaved Areas
  - 1) Compact top 6" of subgrade and each layer of backfill or fill material at 90% maximum dry density.
- d. Pavements
  - 1) Compact top 12" of subbase and each layer of backfill or fill material at 98% maximum dry density.
- e. Crushed Aggregate Base Course
  - 1) Compact top 12" of subgrade and each 6" layer of crushed aggregate base course material to 100% maximum dry density.
- f. Embankment
  - 1) Compact to a density not less than 95% maximum dry density at moisture contents ranging from -3% to +4% of optimum.
- g. Moisture Control
  - 1) Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, taking care to prevent free water appearing on surface during or subsequent to compaction operations.
  - 2) Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
  - 3) Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry.
  - 4) Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by the soils testing agency.
  - 5) Payment for replacement of material that is too wet to compact will not be considered unless the material is still unsuitable after air-drying.
  - 6) The soils testing agency shall declare which materials are suitable or unsuitable.

### 3.09. ROAD SUBGRADE

- A. The road subgrade for bituminous, concrete, and crushed stone pavement areas in fill sections shall consist of a two-foot-thick layer of Select Fill. The Select Fill shall be placed and compacted in accordance with the contract documents.
- B. The road subgrade for bituminous, concrete, and crushed stone pavement areas in cut sections shall consist of firm natural soils as approved by the ENGINEER.
- C. Road subgrades shall be proof rolled.

### 3.10. HANDLING OF SURPLUS MATERIAL

- A. Excavated materials shall not be removed from the site except as specified by the ENGINEER.

1. Materials shall be neatly stockpiled on-site at locations directed by the OWNER.
2. Excess materials shall be compacted and stockpiled in accordance with the CONTRACTOR's fill placement plan.
3. CONTRACTOR shall provide erosion and sedimentation control measures as shown on the drawings and specified in the Contract Documents.

END OF SECTION 311505



## SECTION 312100 - SITE PREPARATION

### PART 1 GENERAL

#### 1.01. SCOPE OF WORK

- A. Furnish all labor, materials, and equipment required and perform all clearing complete as shown on the Drawings and as specified herein.

### PART 2 PRODUCTS (NOT USED)

### PART 3 EXECUTION

#### 3.01. SURVEY

- A. The CONTRACTOR shall stake out the limits of the clearing.

#### 3.02. CLEARING

- A. Cut and remove timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish, and any other objectionable material resting on or protruding through the surface of the ground.
- B. Trees and other vegetation designated on the Drawings or directed by the ENGINEER to remain shall be preserved and protected as specified.

#### 3.03. DISPOSAL

- A. The CONTRACTOR shall dispose of all material and debris from the clearing operation at an approved location or as approved by the OWNER.
- B. Onsite disposal of cleared materials by burning is not allowed.

#### 3.04. PROTECTION

- A. Trees and other vegetation designated on the Drawings or directed by the ENGINEER to remain shall be protected from damage by all construction operations by erecting suitable barriers, guards, and enclosures, or by other approved means.
- B. Clearing operations shall be conducted in a manner to prevent falling trees from damaging trees and vegetation designated to remain and to the work being constructed and so as to provide for the safety of employees and others.
- C. Protection shall be maintained until all work in the vicinity of the work being protected has been completed.
- D. Heavy equipment operation or stockpiling of materials shall not be permitted within the branch spread of existing trees.
- E. Any damage to existing tree crowns, trunks, or root systems shall be repaired immediately.
- F. Roots exposed and/or damaged during the work shall immediately be cut off cleanly inside the exposed or damaged area.
- G. Cut surfaces shall be treated with an acceptable tree wound paint and topsoil spread over the exposed root area.
- H. When work is completed, all dead and downed trees shall be removed.

- I. Live trees shall be trimmed of all dead and diseased limbs and branches.
- J. All cuts shall be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches.
- K. Cuts over 1-in in diameter shall be treated with acceptable tree wound paint.
- L. Construction activities shall be restricted to those areas within the limits of construction designated on the Drawings, within public rights-of-way, and within easements provided by the OWNER.
- M. Adjacent properties and improvements thereon, public, or private, which become damaged by construction operations shall be promptly restored to their original condition to the full satisfaction of the property owner.

END OF SECTION 312100

## SECTION 312150 - SHEETING AND BRACING

### PART 1 GENERAL

#### 1.01. SUMMARY OF WORK

- A. Where required to properly support the surfaces of the excavations to permit construction, to protect the construction work, adjacent work or workmen, adjacent pipelines, and roadways, provide sheeting, bracing, and shoring.
- B. If the ENGINEER is of the opinion that, at any point sufficient or proper supports have not been provided, he may order additional supports at the expense of the CONTRACTOR, but compliance with such orders shall not release the CONTRACTOR from responsibility for the sufficiency of such supports.
- C. The CONTRACTOR may be required, as directed by the ENGINEER, to leave sheeting and bracing in place for the purpose of preventing injury to persons or adjacent construction.
- D. Failure to sheet and brace trenches or other excavations shall be at the CONTRACTOR's risk, and he will be held responsible for caving, settlement, and all other damages or injuries resulting, therefore.
- E. Sheeting and bracing are incidental, and the cost thereof shall be included in the appropriate lump sum or unit price bid for work under this contract.

#### 1.02. QUALITY ASSURANCE

- A. Codes and Standards
  - 1. Department of Labor 29 CFR Part 1926, Occupational Safety and Health Standards Excavation.

### PART 2 PRODUCTS

#### 2.01. SHEETING AND BRACING MATERIALS

- A. Use timber or metal sheeting and bracing components as may be necessary to fulfill the requirements of this Section.

### PART 3 EXECUTION

#### 3.01. INSTALLATION

- A. Install sheeting and bracing by any method, subject to the approval of the ENGINEER.
- B. The ENGINEER's approval will be for the compatibility of the sheeting and bracing system with the ultimate performance of the pipe installation and not intended to imply that the sheeting and bracing fulfills any required or necessary safety requirements for construction.

3.02. REMOVAL

- A. In removing sheeting and bracing after the construction has been completed, take special care to prevent any collapse of the excavation and injury to the completed work or adjacent property.
- B. Trench or other excavation bracing, except that must be left in place, may be removed when the backfilling has reached the respective levels of such bracing.
- C. Remove sheeting, except that which has been ordered left in place, as the backfilling progresses.
- D. Take special care to fill and compact voids created by removal of bracing and sheeting.
- E. Sheeting, shoring, and bracing which is left in place shall be cut off or otherwise left not less than 2' below the established ground surface.

END OF SECTION 312150



## SECTION 312319 - DEWATERING

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work

1. Furnish all labor, equipment, materials, and incidentals necessary for dewatering systems to remove and dispose of all water entering excavations, trenches, or other parts of the work.

##### B. Section Includes:

1. Dewatering system.
2. Water disposal.

#### 1.02. REFERENCE STANDARDS

##### A. OSHA

1. Safety and Health Regulations for Construction

##### B. 15A Subchapter 2C.

#### 1.03. SUBMITTALS

##### A. Section 01 30 00 - Electronic Submittals.

##### B. Dewatering Plan:

1. Dewatering system layout, well depths, well screen lengths, dewatering pump locations, pipe sizes and capacities, grades, filter sand gradations, surface water control devices, valves, and water disposal method and location. Indicate primary and standby power system location and capacity.

##### C. CONTRACTOR Excavation Protection Plans or NCDOT Positive Shoring Plans:

1. Provide sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property.
2. If, due to site conditions or regulations, specific dewatering and/or shoring plans are required, CONTRACTOR shall provide, in accordance with relevant OSHA and NCDOT requirements, ENGINEER-designed sheeting/shoring and/or dewatering system plans. Such designs shall be submitted to the ENGINEER at least 10 days prior to installation.

#### 1.04. QUALITY ASSURANCE

##### A. Comply with authorities having jurisdiction and review methods and procedures related to dewatering including, but not limited to, the following:

1. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
2. Geotechnical report, if one exists.
3. Existing utilities and subsurface conditions.

4. Coordination for interruption, shutoff, capping, and continuation of utility services.
5. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
6. Drilling and abandoning of wells used for dewatering systems.
7. Water discharge and disposal from pumping operations.
8. Testing and monitoring of dewatering system.

1.05. QUALIFICATIONS

A. Licensed Professionals:

1. Professional ENGINEER experienced in design of dewatering systems and licensed in State of North Carolina.
2. Professional land surveyor with minimum three years' experience and licensed in the state of North Carolina.

PART 2 PRODUCTS

2.01. PERFORMANCE AND DESIGN CRITERIA

A. Design:

1. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
2. Lower water table within areas of excavation to minimum one (1) foot below bottom of excavation to permit Work to be completed on dry and stable subgrade.
3. Relieve hydrostatic pressures in confined water bearing strata below excavation to eliminate risk of hydrostatic uplift of pipe or structures or other instability of excavation.
  - a. Prevent damage to adjacent properties, buildings, sidewalks, pavements, structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
  - b. Maintain piezometric water level a minimum of twenty-four (24) inches below surface of excavation.
4. Prevent loss of fines, quick condition, or softening of foundation subgrade.
  - a. Protect from undermining, washout, and damage by rain or water accumulation.
  - b. Soils which become soft, loose, "quick", or otherwise unsatisfactory for support of structures, earthen or man-made, because of inadequate excavation, dewatering, proofrolling, or other construction methods shall be removed and replaced as required by the ENGINEER at the CONTRACTOR's expense.
5. Maintain stability of sides and bottoms of excavations and trenches.

6. Surface Water Control System: Collect and remove surface water and seepage entering excavation.
  - a. Prevent surface water from entering excavations by temporary grading, dikes, or other means.
  - b. Prevent surface water from accumulating in trenches and other excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
  - c. Do not use excavated trenches as temporary drainage ditches. Divert water from these areas without causing damage to adjacent property.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

##### A. Utility Service Locator:

1. Call local utility service-line information at **811** not less than three working days before performing Work.
2. Request that underground utilities be located and marked within and immediately surrounding Site.
3. Identify required lines, levels, contours, and data.

#### 3.02. DEWATERING SYSTEM

##### A. General Dewatering:

1. Grade and maintain all areas of the site to preclude surface runoff into excavations and prevent ponding of water.
2. Remove all soil softened or eroded by the presence of water and replace with suitable backfill material.
3. Provide and maintain drainage and dewatering equipment to remove and dispose of all surface water and ground water entering excavations, or other parts of the Work areas. Keep excavations dry during execution of Work, subgrade preparation, and continually thereafter until the pipeline or structure to be built therein is acceptable to ENGINEER and backfilling operations are completed and acceptable to ENGINEER.
4. Provide temporary drainage ditches and temporary dikes and provide required temporary pumping and other work necessary for diverting or removing rainfall and all other accumulations of surface water from excavations and fill areas. Perform diversion and removal of surface water in manner that prevents accumulation of water behind permanent or temporary structures and at any other locations in the construction area where such accumulations may be detrimental.
5. Water used for working or processing, resulting from dewatering operations, or containing oils or sediments that will reduce the quality of the surface water or groundwater downstream of the point of discharge, shall not be directly discharged. Divert such waters through temporary settling basin or filter before discharging to surface water, groundwater, or drainage routes.

6. CONTRACTOR shall be responsible for condition of piping, conduits, and channels used for drainage and such piping, conduits, and channels shall be clean and free of sediment.

B. Temporary Dewatering Systems:

1. CONTRACTOR shall design, provide, and operate dewatering system to include sufficient trenches, sumps, pumps, hose, piping, well points, deep wells, and similar facilities, necessary to depress and maintain groundwater level below the base of each excavation during all stages of construction operations.
2. Design and operate dewatering system to avoid settlement and damage to existing structures and underground facilities.
3. Groundwater table shall be lowered in advance of excavation for a sufficient period of time to allow dewatering of fine grain soils.
4. Maintain groundwater level at excavations a minimum of 1-foot below lowest subgrade excavation until the structure has sufficient strength and weight to withstand horizontal and vertical soil and water pressures from natural groundwater.
5. Operate dewatering system continuously, 24-hours per day, 7-days per week.
6. Provide standby pumping facilities and personnel to maintain the continued effectiveness of the system. Do not discontinue dewatering operations without first obtaining ENGINEER's acceptance for such discontinuation.
7. Locate elements of temporary dewatering system to allow continuous dewatering operation without interfering with the Work to the extent practicable.
8. Where portions of dewatering system are located in the area of permanent construction, submit to and obtain ENGINEER's acceptance of details of proposed methods of constructing the Work at such location. Control of ground water shall continue until the permanent construction provides sufficient dead load to withstand hydrostatic uplift of the normal groundwater, until concrete has attained sufficient strength to withstand earth and hydrostatic loads, and until waterproofing Work is completed.
9. Perform pumping of water from excavations in a manner that prevents carrying away of unsolidified concrete materials, and that avoids damaging the subgrade.

3.03. WATER DISPOSAL

- A. Dewatering system shall discharge in accordance with the NC Sedimentation Pollution Control Act, NCDEQ Erosion Control Permit, and NC Stormwater Permit for Construction Activities.
- B. Convey water from excavations in closed conduits. Do not use trench excavations as temporary drainage ditches.
- C. Dispose of water removed from excavations in a manner that does not endanger health and safety, property, the Work, and other portions of the Project.
- D. Dispose of water in manner that causes no inconvenience to OWNER, others involved in the Project, and adjacent and downstream properties.

3.04. SYSTEM REMOVAL

- A. Remove dewatering and surface water control systems after dewatering operations are no longer required.
- B. Abandon wells and piezometers when dewatering is completed in accordance with 15A Subchapter 2C.
- C. Repair damage caused by dewatering and surface water control systems or resulting from failure of systems to protect property.

3.05. FIELD QUALITY CONTROL

A. Testing:

- 1. After dewatering system is installed, perform pumping test to determine at what point selected pumping rate lowers water level in well below pump intake.
- 2. Adjust pump speed, discharge volume, or both to ensure proper operation of each pump.

B. Monitoring and Recording:

1. Daily:

- a. Note average discharge flow rate for dewatering system.
- b. Observe and record elevation of ground water and piezometric water levels in observation wells.

2. Sand Content:

- a. Monitor ground water discharge for sand content.
- b. Sample and test water from each well weekly for sand content.
- c. Maximum Permitted Sand Content: 5 ppm.
- d. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

3. Contaminants:

- a. Monitor ground water discharge for contamination while performing pumping in vicinity of potentially contaminated sites.

4. Existing Adjacent Buildings, Structures, and Improvements:

- a. Observe weekly and maintain an accurate log of surveyed elevations during dewatering to detect movement in comparison to original elevations.
- b. Notify ENGINEER immediately of measured movement or if cracks, sags, or other damage is evident in adjacent construction.

END OF SECTION



## SECTION 312323.33 - FLOWABLE FILL

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary for the installation of flowable fill in accordance with the plans. All materials, testing, and procedures shall be of the type specified herein.

##### B. Section Includes:

1. Flowable fill for:
  - a. Structure backfill.
  - b. Utility bedding.
  - c. Utility backfill.
  - d. Filling abandoned utilities.

#### 1.02. DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, manhole, tank, or cable.
- B. Excavatable Flowable Fill: Lean cement concrete fill used where future excavation may be required, such as fill for utility trenches, bridge abutments, and culverts.
- C. Non-excavatable Flowable Fill: Lean cement concrete fill used where future excavation is not anticipated, such as fill below structure foundations and filling abandoned utilities.

#### 1.03. REFERENCE STANDARDS

##### A. ASTM International:

1. ASTM C33 - Standard Specification for Concrete Aggregates.
2. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
3. ASTM C150 - Standard Specification for Portland Cement.
4. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
5. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
6. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
7. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
8. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
9. ASTM C1040 - Standard Test Methods for Density of Unhardened and Hardened Concrete in Place by Nuclear Methods.

#### 1.04. SUBMITTALS

- A. Section 01 30 00 - Electronic Submittals.
  - B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
  - C. Field Quality-Control Submittals:
    - 1. Mix Design:
      - a. Furnish flowable fill mix design for each specified strength.
      - b. Furnish separate mix designs when admixtures are required for the following:
        - 1) Flowable fill Work during hot and cold weather.
        - 2) Air entrained flowable fill Work.
      - c. Identify design mix ingredients, proportions, properties, admixtures, and tests.
    - 2. Furnish test results to certify flowable fill mix design properties meet or exceed specified requirements.
  - D. Delivery Tickets:
    - 1. Furnish duplicate delivery tickets indicating actual materials delivered to Project Site.
  - E. Qualifications Statements:
    - 1. Submit qualifications for supplier.
- 1.05. QUALIFICATIONS
- A. Supplier:
    - 1. Company specializing in supplying products specified in this Section with minimum three years' documented experience.
    - 2. Product source approved by authority having jurisdiction.
- 1.06. ENVIRONMENTAL REQUIREMENTS
- A. Minimum Conditions: Do not install flowable fill during inclement weather or when ambient temperature is less than 40° F.
- 1.07. FIELD MEASUREMENTS
- A. Verify field measurements before installing flowable fill to establish quantities required to complete the Work.

## PART 2 PRODUCTS

- 2.01. FLOWABLE FILL
- A. Where applicable, furnish materials according to State of North Carolina Department of Transportation Standard Specifications for Roads and Structures, (latest revision).
- 2.02. MATERIALS
- A. Portland Cement: ASTM C150 Type I - Normal; Edit the following Paragraph to suit local conditions and aggregate supply. Itemize gradation when special aggregates are required.
  - B. Fine Aggregates: ASTM C33.



- C. Water: ASTM C94. Clean and not detrimental to concrete.
- 2.03. ADMIXTURES
  - A. Air Entrainment: ASTM C260.
  - B. Chemical Admixture: ASTM C494.
  - C. Fly Ash: ASTM C618 Class C or F obtained from residue of electric generating plant using ground or powdered coal.
  - D. Plasticizing: ASTM C1017.
- 2.04. MIXES
  - A. Mix and deliver flowable fill according to ASTM C94, Option C.
  - B. Flowable Fill Design Mix:
    - 1. Cement Content:
      - a. Excavatable: 75 to 100 lb/cu yd.
      - b. Non-Excavatable: 100 to 150 lb/cu yd.
    - 2. Fly Ash Content:
      - a. Excavatable: None.
      - b. Non-Excavatable: 150-600 pcf.
    - 3. Air Entrainment:
      - a. Excavatable: 5 to 35 percent.
      - b. Non-Excavatable: 5 to 15 percent.
    - 4. 28-Day Compressive Strength:
      - a. Excavatable: Maximum 100 psi.
      - b. Non-Excavatable: Minimum 125 psi.
    - 5. Density:
      - a. Excavatable: 80 to 110 pcf.
      - b. Non-Excavatable: 100 to 125 pcf.
    - 6. Temperature, Minimum, at Point of Delivery:
      - a. Excavatable: 50° F.
      - b. Non-Excavatable: 50° F.
  - C. Provide water content in design mix to produce self-leveling, flowable fill material at time of placement.
  - D. Design mix air entrainment and unit mass are for laboratory design mix and source quality control only.
- 2.05. SOURCE QUALITY CONTROL
  - A. Test and analyze properties of flowable fill design mix and certify results for the following:

1. Design mix proportions by weight of each material.
  2. Aggregate: ASTM C33 for material properties and gradation.
  3. Properties of plastic flowable fill design mix including:
    - a. Temperature.
    - b. Slump.
    - c. Air entrainment.
    - d. Wet unit mass.
    - e. Yield.
    - f. Cement factor.
  4. Properties of hardened flowable fill design mix including:
    - a. Compressive strength at 1 day, 7 days, and 28 days. Report compressive strength of each specimen and average specimen compressive strength.
    - b. Unit mass for each specimen and average specimen unit mass at time of compressive strength testing.
- B. Prepare delivery tickets containing the following information:
1. Project designation.
  2. Date.
  3. Time.
  4. Class and quantity of flowable fill.
  5. Actual batch proportions.
  6. Free moisture content of aggregate.
  7. Quantity of water withheld.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

- A. Verify excavation or trenching is complete.
- B. Verify utility installation is complete and tested before placing flowable fill.
- C. Verify excavation is dry and dewatering system is operating, if necessary.

#### 3.02. PREPARATION

- A. Support and restrain utilities to prevent movement and flotation during installation of flowable fill.
- B. Protect structures and utilities from damage caused by hydraulic pressure of flowable fill before fill hardens.
- C. Protect utilities and foundation drains to prevent intrusion of flowable fill.

#### 3.03. INSTALLATION - FILL, BEDDING, AND BACKFILL

- A. Where indicated on Drawings or approved by ENGINEER, flowable fill may be used for bedding, fill, and backfill.
  - B. Place flowable fill by chute, pumping or other methods approved by ENGINEER.
    - 1. When required, place flowable fill under water using tremie procedure.
    - 2. Do not place flowable fill through flowing water.
  - C. Place flowable fill in lifts to prevent lateral pressures from exceeding structural capacity of structures and utilities.
  - D. Place flowable fill evenly on both sides of utilities to maintain alignment.
  - E. Place flowable fill in locations and to elevations indicated on Drawings without vibration or other means of compaction.
- 3.04. INSTALLATION - FILLING ABANDONED UTILITIES
- A. Utility pipes within the NCDOT ROW that meet the description in NCDOT Standard Specifications for Roads and Structures shall be abandoned as specified therein. Additionally, other pipes and conduits may be abandoned as follows when indicated on Drawings or when designated by ENGINEER.
  - B. Verify pipes and conduits are not clogged and are sufficiently empty to permit gravity installation of flowable fill for entire length indicated to be filled.
  - C. Seal lower end of pipes and conduits by method to contain flowable fill and to vent trapped air caused by filling operations.
  - D. Place flowable fill using method to ensure there are no voids.
    - 1. Fill pipes and conduits from high end.
    - 2. Fill manholes, tanks, and other structures from grade level access points.
  - E. After filling pipes and conduits seal both ends.
- 3.05. FIELD QUALITY CONTROL
- A. The OWNER may conduct inspection and testing according to ASTM C94. Allow access to site and all applicable materials for inspection and testing.
  - B. The OWNER may conduct in-place penetration (density) tests using handheld penetrometer to measure penetration resistance of hardened flowable fill according to ASTM C403.
  - C. The OWNER may conduct in-place density tests using nuclear test device according to ASTM C1040.
  - D. Defective Flowable Fill: Fill failing to meet the following test requirements or fill delivered without the following documentation.
    - 1. Test Requirements:
      - a. Minimum temperature at point of delivery.
      - b. Compressive strength requirements for each type of fill.
    - 2. Documentation: Duplicate delivery tickets.

3. Defective flowable fill shall not be incorporated into the project and will immediately be removed from the project site and replaced at no additional cost to the OWNER.

3.06. CLEANING

- A. Remove spilled and excess flowable fill from Project Site.
- B. Restore facilities and Site areas damaged or contaminated by flowable fill installation to existing condition before installation.

END OF SECTION 312323.33

## SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to implement erosion and sedimentation control methods in accordance with the plans. All materials, testing, and procedures shall be of the type specified herein.

##### B. Section Includes:

1. Temporary Silt Fencing
2. Diversion Channels
3. Utility Trenches
4. Ditch Liner Matting
5. Check Dams
6. Sediment Basins
7. Sediment Traps
8. Inlet Protection
9. Site Stabilization

#### 1.02. REFERENCES

##### A. ASTM International:

1. ASTM C33 - Standard Specification for Concrete Aggregates.

##### B. North Carolina Department of Environmental Quality

1. Erosion and Sediment Control Planning and Design Manual, Latest Revision

##### C. North Carolina Department of Transportation

1. Standard Specifications for Roads and Structures, Latest Revision

##### D. Local Authorities Having Jurisdiction

1. Where local authorities having jurisdiction have requirements more restrictive than those referenced in this section, all sediment and erosion control measures shall be designed, constructed, and maintained in accordance with the most restrictive of these requirements.

#### 1.03. SUBMITTALS

##### A. Section 01 30 00 - Electronic Submittals.

##### B. Product Data: Submit manufacturer's technical data and material samples on geotextiles.

##### C. Test Reports: Indicate certified tests results for precast concrete at manufacturing facility and granular backfill.

- D. Manufacturer's Certificate: Submit material certificates signed by manufacturer and CONTRACTOR certifying Products including posts, filter stone, riprap, and other products (if requested) meet or exceed specified requirements.
  - E. Drawings: Submit scaled drawings of changes in facilities shown on Drawings and additional facilities proposed by CONTRACTOR.
    - 1. Submit any proposed facilities or materials different from those shown on the Drawings or specified herein.
- 1.04. QUALITY ASSURANCE
- A. All construction activities required under this project shall comply with the North Carolina Sedimentation Pollution Control Act of 1973 and the rules and regulations promulgated pursuant to the provisions of that law.
  - B. Install and maintain erosion control devices as required to function properly and to satisfy the representatives of the North Carolina Department of Environmental Quality (NCDEQ), Department of Energy, Mineral, and Land Resources (DEMLR), local authorities having jurisdiction, and the ENGINEER.
    - 1. Any time delays experienced due to a shutdown by the N. C. Land Quality Section, other authorities having jurisdiction, or due to unanticipated corrective work will not receive any time extensions on the contract.
    - 2. The CONTRACTOR is responsible for installing all devices necessary to control runoff from the site, regardless of any conditions of the permit or design by the ENGINEER.

## PART 2 PRODUCTS

### 2.01. STONE AND GEOTEXTILE MATERIALS

- A. Stone:
  - 1. Erosion Control Stone
    - a. Comply with NCDOT Standard Specifications for Roads and Structures.
  - 2. Drainage Stone
    - a. Drainage stone, washed, uniformly graded mixture of crushed stone, or crushed or uncrushed gravel conforming to Coarse Aggregate No. 57 or ASTM C33 to be used as specified.
  - 3. Check Dam
    - a. Class B erosion control stone shall be used.
- B. Geotextile Fabric: Furnish according to state of North Carolina Department of Environmental Quality standards.
  - 1. Separator geotextile fabric shall be a woven slit film or monofilament synthetic fabric consisting of polyester or polypropylene to be approved by ENGINEER. Geotextile shall be treated to resist degradation due to exposure to ultraviolet light.
- C. Silt Fence: Comply with North Carolina DEQ Erosion and Sediment Control Planning and Design Manual, Latest Revision

1. Use a synthetic filter fabric of at least 95% by weight of polyolefins or polyester, which is certified by the manufacturer or suppliers as conforming to the requirements in ASTM D 6461, shown in the following table:

Temporary Silt Fence Material Property Requirements					
	Test Material	Units	Supported Silt Fence <sup>1</sup>	Unsupported <sup>1</sup> Silt Fence	Type of Value
Grab Strength	ASTM D 4632	N (lbs)			
Machine Direction			400	550	MARV
			(90)	(90)	
X-Machine Direction			400	450	MARV
			(90)	(90)	
Permittivity	ASTM D 4491	sec-1	0.05	0.05	MARV
Apparent Opening Size <sup>2</sup>	ASTM D 4751	mm	.060	0.60	Max MARV <sup>3</sup>
		(US Sieve #)	(30)	(30)	
Ultraviolet Stability	ASTM D 4355	% Retained Strength	70% after 500h of exposure	70% after 500h of exposure	Typical
<sup>1</sup> Silt Fence support shall consist of 14-gauge steel wire with a mesh spacing of 150 mm (6 inches), or prefabricated polymer mesh of equivalent strength.					
<sup>2</sup> These default values are based on empirical evidence with a variety of sediment. For environmentally sensitive areas, a review of previous experience and/or site or regionally specific geotextile tests in accordance with Test Method D 5141 should be performed by the agency to confirm suitability of these requirements.					
<sup>3</sup> As measured in accordance with Test Method D 4632.					

- a. Synthetic filter fabric should contain ultraviolet ray inhibitors and stabilizers to provide a minimum of 6 months of expected usable construction life at a temperature of 120°F
2. Posts for sediment fences shall be steel with a minimum unit weight of 1.25 lb/linear ft with a minimum length of 5 ft. Steel posts shall have projections to facilitate fastening of the fabric.
3. For reinforcement of standard strength filter fabric, use wire fence with a minimum 14 gauge and a maximum mesh spacing of 6 inches.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support devices and imposed loads.
- B. Verify gradients and elevations of base or foundation for other work are correct.

#### 3.02. GENERAL SCHEDULE

- A. Notify the appropriate State of North Carolina Department of Environmental Quality officials and/or other local authorities having jurisdiction of construction commencement and schedule pre-construction conference, if required, with State officials, local authorities, and ENGINEER.
- B. Install construction entrances, silt fence, stone drains, check dams, and other measures as shown on the approved plan. Clear only as required to install these devices.
- C. Once temporary erosion and sedimentation control measures are in place, begin clearing and grubbing. Delay grading in areas that would reduce the minimum dimensions of sediment control basins. Stockpile topsoil and suitable fill material. Install silt fence around stockpile areas. Dispose of unsuitable soils and all other waste materials off-site in a legal manner.
  1. Seed temporary diversions, berms, and basins immediately after construction.
- D. Groundcover shall be provided according to the following schedule:

Ground Stabilization Chart		
Site Area Description	Stabilization	Timeframe Exceptions
Dikes, swales, ditches, and slopes	7 Days	None
High Quality Water (HQW) zones	7 Days	None
Slopes steeper than 3:1	7 Days	If slopes are 10' or less in length and are not steeper than 2:1, 14 days are allowed
Slopes 3:1 or flatter	14 Days	7 days for slopes greater than 50' in length
All other areas with slopes flatter than 4:1	14 Days	None, except for perimeters and HQW zones

### 3.03. TEMPORARY SILT FENCING

- A. Provide silt fences where shown on the Drawings and as necessary to prevent erosion.
- B. Install silt fence in accordance with the details shown on the Drawings.
- C. Posts to be 1.33 lb/linear foot steel.
- D. Install silt fence on low side of stockpiles and in locations shown on the Drawings. Extend fence around approximately 90% of the perimeter of the stockpile.

### 3.04. DIVERSION CHANNELS

- A. Provide diversion ditches and dikes as necessary or as shown on the approved plans to prevent concentrated flow of water across disturbed areas.
- B. Windrow excavated material on low side of channel.
- C. Compact to 95 percent maximum density.
- D. On entire channel area, apply soil supplements and sow seed as specified.
- E. Mulch seeded areas with hay as specified.



3.05. UTILITY TRENCHES

- A. Stockpile excavated material on the opposite side of the utility trenches from the watercourses to the extent that is permissible.
  - 1. In the event that stockpiles are placed on the watercourse side of the trench, provide silt fence or silt berms with stone filter outlets along the entire length of the stockpile that is on the watercourse side of the trench. The placement of these measures shall be at no additional cost to the OWNER.

3.06. SEDIMENT BASINS AND TEMPORARY SEDIMENT TRAPS

- A. Construct sediment basins and temporary sediment traps in accordance with NCDEQ Erosion and Sediment Control Planning and Design Manual and requirements of local authorities having jurisdiction to indicated shape(s) and depth(s).
- B. Provide a settling basin with a gravel filter outlet for all water pumped from trenches or dewatering equipment. Pumping of that water directly into any stream, pond, or watercourse is prohibited.

3.07. CHECK DAM

- A. Construct temporary check dams in accordance with NCDEQ Erosion and Sediment Control Planning and Design Manual and requirements of local authorities having jurisdiction.
- B. Construct check dams to dimensions shown on the Drawings.
- C. Rip rap shall not exceed 24" in height at center and slope shall be 2:1.

3.08. INLET PROTECTION

- A. Construct all temporary inlet protection measures in accordance with NCDEQ Erosion and Sediment Control Planning and Design Manual and requirements of local authorities having jurisdiction.
- B. Each type of inlet protection required shall be as shown on the drawings.
- C. Fabric Inlet Protection
  - 1. Space 2 x 4-inch wood (or equivalent metal) stakes evenly around the perimeter of the inlet a maximum of three feet apart, and securely drive them into the ground a minimum of 24" deep.
  - 2. To provide needed stability, frame with 2 x 4-inch wood strips around the crest of the overflow area at a maximum of 1.5 feet above the drop inlet crest.
  - 3. Place the bottom 12 inches of fabric in a trench and backfill the trench with at least four inches of crushed stone or 12 inches of compacted soil.
  - 4. Fasten fabric securely to the stakes and frame so that joints overlap to the next stake.
  - 5. It may be required to build a dike on the down slope side of the inlet in order to prevent bypass flow.
- D. Curb Inlet Protection
  - 1. Lay concrete blocks on pavement 6" from curb inlet. Place blocks against the drain inlet for lateral support.

2. Place at least one concrete block on its side in each bottom row of blocks.
3. Place wire mesh with ½" openings over all block openings used for drainage.

3.09. SITE STABILIZATION

- A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time to minimize soil erosion, siltation, and water and air pollution to adjacent properties and walkways caused by operations. Comply with the applicable regulations of all authorities having jurisdiction relating to pollution prevention and control. In the event of conflict between such regulations and the requirements of the Specifications, the more restrictive requirements shall apply.
- B. Exercise every reasonable precaution throughout the life of the project to prevent the eroding of soil and the silting of rivers, streams, lakes, reservoirs, other water impoundments, ground surfaces, or other property.
- C. Construct, stabilize, and activate erosion controls before site disturbance within tributary areas of those controls.
  1. Maintain diversions, inlet protection, and sediment basins until site is completely stabilized.
- D. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2: 1 or flatter.
- E. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.
  1. During non-germinating periods, apply mulch at recommended rates.
  2. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year as specified.
- F. Stabilize diversion channels, sediment traps, and stockpiles immediately.
- G. All areas to be paved shall be stabilized with stone as soon as they are brought to final grade.
- H. Pipe Outlet Stabilization
  1. Ensure that the subgrade for the riprap and filter fabric follows the required lines and grades as shown on the drawings. Compact any fill required in the subgrade to the density of the surrounding undisturbed soil. Low areas in the subgrade on undisturbed soil shall be filled by increasing the thickness for the riprap.
  2. The riprap and filter fabric shall conform to the specified grade and dimension as shown on the drawings.
  3. Riprap may be placed by machine, but take care to avoid damaging the filter fabric.
  4. Protect the filter fabric from puncturing and tearing during installation. Repair damaged fabric by removing the riprap and placing a new piece of fabric over the damaged area. All connecting joints shall overlap a minimum of 12-inches in all directions. Replace the entire filter fabric as directed by the OWNER or ENGINEER.
  5. The minimum thickness of the riprap shall be 1.5 times the maximum stone diameter.

6. Construct the apron on zero grade with no over fall at the end. The top of the riprap at the downstream end shall be level with the receiving area.
7. Construct the apron so it is properly aligned with the receiving stream.
8. Immediately after construction, stabilize all disturbed area with the proper vegetate cover

### 3.10. FIELD QUALITY CONTROL

- A. Inspect erosion control devices on a weekly basis and after each runoff event until permanent vegetation has been established. Required corrective/maintenance measures shall be implemented immediately.
- B. Structures and measures that shall be inspected include:
  1. Inlet Protection: Replace any fabric that collapses, tears, decomposes, or become ineffective will be replaced immediately. Remove sediment deposits behind fence when sediment accumulates to six inches.
  2. Construction Entrance & Exit: Inspect construction entrances and exits for condition of surface. Top-dress with new stone when needed.
  3. Silt Fence: Any fabric that collapses, tears, decomposes, or becomes ineffective, will be replaced immediately.
  4. Rock Check Dams and Stone Drains: Inspect for significant erosion around the edges and between dams. Install protective riprap liners in portions of the channel where erosion occurs. Remove sediment accumulated behind the dams as required to prevent damage to channel vegetation. Add stones to dams as required to maintain design height and cross section.
  5. Pipe Outlet Stabilization: Inspect riprap structure after heavy rains to see if any erosion around or below the structure or if stones have been dislodged. Immediately make all necessary repairs to prevent future damage.

### 3.11. CLEANING

- A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment and restore the structure to its original constructed conditions.
  1. Replace the contaminated part of the gravel.
  2. Check the structure for damage and maintain the spillway at a minimum of 1.5-feet below the low point of the embankment.
  3. Repair damage immediately. When settlement of the embankment occurs, place fill 6-inches above the design grade. Replace riprap when displaced from the spillway.
- B. Remove sediment deposits behind silt fence when sediment accumulates to 6".
- C. Clean channels when depth of sediment reaches approximately one-half channel depth.
- D. Do not damage structures or devices during cleaning operations.
- E. Do not permit sediment to erode into construction or site areas or natural waterways during cleaning procedures.

- F. Clean sediment transported onto public roads at the end of each day. Sediment shall be removed by shoveling or sweeping and be transported to a controlled disposal area. Street washing shall be allowed after sediment is removed in this manner.

3.12. CLOSEOUT ACTIVITIES

- A. When construction is complete and all areas are stabilized, call for an inspection by an environmental inspector.
- B. If site is approved, removed any temporary diversion channels, re-grade to natural grade or as shown on plans and seed or stabilize any resulting bare areas.
- C. When vegetation has become established, call for a final site inspection by an environmental inspector. Obtain certificate of completion and remove all erosion control measures within 30 days. Restore and stabilize areas disturbed during removal.

END OF SECTION

## SECTION 312510 - SURFACE RESTORATION

### PART 1 GENERAL

#### 1.01. THE REQUIREMENT

- A. Provide all labor, equipment, and materials necessary for final grading, topsoil placement, and miscellaneous site work not included under other Sections but required to complete the work as shown on the Drawings and specified herein.

### PART 2 MATERIALS

#### 2.01. TOPSOIL

- A. Topsoil shall be as specified.

### PART 3 EXECUTION

#### 3.01. FINAL GRADING

- A. Following approval of rough grading the subgrade shall be prepared as follows:
  - 1. For riprap, bare soil 18-inches below finish grade or as directed by ENGINEER.
  - 2. Where burning has been performed, distribute ashes evenly over the area to receive topsoil.
  - 3. For topsoil, scarify 2-inches deep prior to placing.

#### 3.02. TOPSOIL PLACEMENT

- A. Topsoil shall be placed over all areas disturbed during construction under any contract except those areas that will be paved, graveled or rip rapped.
- B. Topsoil shall be spread in place for lawn and road shoulder seed areas at a 4-inch consolidated depth and at a sufficient quantity for plant beds and backfill for shrubs and trees.
- C. Topsoil shall not be placed in a frozen or muddy condition.
- D. Final surface shall be hand or mechanically raked to an even finished surface to finish grade as shown on Drawings.
- E. All stones and roots over 4-inches and rubbish and other deleterious materials shall be removed and disposed of.

END OF SECTION 312510



## SECTION 312910 - MISCELLANEOUS WORK AND CLEANUP

### PART 1 GENERAL

#### 1.01. SCOPE OF WORK

- A. Furnish all labor, materials, equipment, and incidentals required to do the miscellaneous work not specified in other sections but obviously necessary for the proper completion of the work as shown on the Drawings.
- B. When applicable the CONTRACTOR shall perform the work in accordance with other sections of this Specification.
- C. When no applicable specification exists, the CONTRACTOR shall perform the work in accordance with the best modern practice and/or as directed by the ENGINEER.
- D. The work of this Section includes, but is not limited to, the following:
  - 1. Crossing and relocating existing utilities
  - 2. Restoring of driveways and sidewalks
  - 3. Cleaning up
  - 4. Incidental work
  - 5. Job photographs
  - 6. Protection and/or removal and reinstallation of signs
  - 7. Restoration of and replacement of curbing
  - 8. Protection and bracing of utility poles
  - 9. Restoring easement and rights-of-way
- E. Temporary facilities

### PART 2 PRODUCTS

#### 2.01. MATERIALS

- A. Materials required for this Section shall be the same quality of materials that are to be restored.
- B. Where possible, the CONTRACTOR may re-use existing materials that are removed.

### PART 3 EXECUTION

#### 3.01. CROSSING AND RELOCATING EXISTING UTILITIES

- A. This Item includes any extra work required in crossing culverts, water courses, including brooks and drainage ditches, storm drains, gas mains, water mains, electric, telephone, gas, and water services, and other utilities.
- B. This work shall include but is not limited to the following: bracing, hand excavation and backfill (except screened gravel) and any other work required for crossing the utility or obstruction not included for payment in other items of this specification.

- C. In locations where existing utilities cannot be crossed without interfering with the construction of the work as shown on the Drawings, the CONTRACTOR shall remove and relocate the utility as directed by the ENGINEER or cooperate with the Utility Companies concerned if they relocate their own utility.
  - D. At pipe crossings and as designated by the ENGINEER, the CONTRACTOR shall furnish and place screened gravel bedding so that the existing utility or pipe is firmly supported for its entire exposed length.
  - E. The bedding shall extend to the mid-diameter of the pipe crossed. Payment for screened gravel at pipe crossings shall be included as an incidental cost to the unit price for the proposed pipeline established in the Bid Form.
- 3.02. CLEANING UP DURING CONSTRUCTION
- A. Execute periodic cleaning to keep the Work, the site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris, resulting from construction operations.
  - B. Provide onsite containers for the collection of waste materials, debris, and rubbish.
  - C. Remove waste materials, debris, and rubbish from the site periodically and dispose of at an approved facility.
  - D. Upon approval of the OWNER, selected waste may be disposed at the active construction and demolition disposal area on the site.
- 3.03. FINAL CLEANING
- A. The CONTRACTOR shall remove all construction material, excess excavation, buildings, equipment, and other debris remaining on the job as a result of construction operations and shall restore the site of the work to a neat and orderly condition.
  - B. Prior to final completion, or OWNER occupancy, ENGINEER shall conduct an inspection of all work areas to verify that the entire work area is clean.
- 3.04. INCIDENTAL WORK
- A. Do all incidental work not otherwise specified, but obviously necessary to the proper completion of the Contract as specified and as shown on the Drawings.
- 3.05. TEMPORARY FACILITIES
- A. The CONTRACTOR shall furnish, install, maintain, and remove all temporary facilities required for construction or called for in the specifications.

END OF SECTION 312910



## SECTION 321123 - AGGREGATE BASE COURSES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Aggregate subbase.
2. Aggregate base course.

#### 1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.

B. ASTM International:

1. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.

C. North Carolina Department of Transportation (NCDOT):

1. NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications):
  - a. Section 520 - Aggregate Base Course.
  - b. Section 1010 - Aggregate for Non-Asphalt Type Bases.

#### 1.3 SUBMITTALS

A. Section 013300 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit data for geotextile fabric and herbicide.

C. Materials Source: Submit name of aggregate materials suppliers.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Prior to Production:

1. Identify aggregate source.
2. Submit test results indicating aggregate meets material requirements of NCDOT Specifications.
3. Submit job-mix gradation indicating single value for each sieve size required.

- F. Changes to Job-Mix Gradation: Submit in writing prior to start of day's production. Changes are subject to approval.
- G. Submit quality control test results within 24 hours after testing is completed.

#### 1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Perform Work according to NCDOT of standards.

### PART 2 - PRODUCTS

#### 2.1 AGGREGATE MATERIALS

- A. Aggregate Base Course: Well-graded, clean, hard, tough, durable, and sound mineral aggregates consisting of crushed stone, crushed gravel, or crushed slag; free of organic matter and contamination from chemical or petroleum products; meeting the requirements of Division 10 within the NCDOT Standard Specifications for Roads and Structures.

#### 2.2 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Section 013000 - Administrative Requirements: Verification of existing conditions before starting Work.
- B. Verify compacted substrate is dry and ready to support paving and imposed loads.
  - 1. Proof roll substrate with 20-ton tandem axle dual wheel dump truck loaded to the legal limit with the tires inflated to 100 psi in minimum in two perpendicular passes to identify soft spots. Proof roll shall be done in the presence of the RPR and/or authorities having jurisdiction.
  - 2. Soft areas of the substrate that deflect more than 1 inch or show permanent deformations greater than 1 inch shall be removed and replaced with suitable materials or reworked to conform to the moisture content and compactions requirements in accordance with these specifications. Remove soft substrate and replace with compacted fill as specified in Section 312323.
- C. Verify substrate has been inspected, gradients and elevations are correct.

### 3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place fill on soft, muddy, or frozen surfaces.
- C. Do not place aggregate base course until subgrade is accepted by ENGINEER or authorities having jurisdiction.

### 3.3 AGGREGATE PLACEMENT

- A. Install geotextile fabric over subgrade according to manufacturer's instructions.
  - 1. Lap ends and edges minimum 6 inches.
  - 2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.
- B. Spread aggregate over prepared substrate and compact in accordance with NCDOT Specifications.
- C. Roller compact aggregate to 95 percent maximum density.
- D. Level and contour surfaces to elevations, profiles, and gradients indicated.
- E. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
- F. Maintain optimum moisture content of fill materials to attain specified compaction density.
- G. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

### 3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.
- C. Maximum Variation From Thickness: 1/4 inch.
- D. Maximum Variation From Elevation: 1/2 inch.

### 3.5 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements and 017000 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Compaction testing will be performed according to NCDOT Specifications.

- C. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- D. Frequency of Tests: In accordance with NCDOT Specifications.

3.6 COMPACTION

- A. Compact materials to 98 percent of maximum density as determined from test strip, according to ASTM D2940.

END OF SECTION 321123

## SECTION 321216 - ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Asphalt materials.
2. Aggregate materials.
3. Aggregate subbase.
4. Asphalt paving base course, binder course, and wearing course.
5. Asphalt paving overlay for existing paving.
6. Surface slurry.

#### 1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
2. AASHTO M320 - Standard Specification for Performance-Graded Asphalt Binder.

B. North Carolina Department of Transportation (NCDOT):

1. NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications):
  - a. Section 600 – Prime Coat.
  - b. Section 605 – Asphalt Tack Coat.
  - c. Section 607 – Milling Asphalt Pavement.
  - d. Section 609 – Quality Management System for Asphalt Pavements.
  - e. Section 610 – Asphalt Concrete Plant Mix Pavements.
  - f. Section 620 - Asphalt Binder for Plant Mix.
  - g. Section 657 - Sealing Existing Pavement Cracks and Joints.

C. NCDOT Asphalt Quality Management System, Materials and Tests Unit, Asphalt QMS Manual (QMS Manual), latest edition.

#### 1.3 DEFINITIONS

A. Lot: Number of tons of asphalt pavement placed in production day.

B. Minor Target Change: Change from verified mix design gradation target on maximum of two sieves with limitations as follows:

1. Maximum allowable change in target gradation on #8 or any coarser sieve is limited to 3 percent passing per sieve.

2. Maximum allowable change in target gradation on #16 or #50 sieves is 2 percent passing per sieve.
  3. Maximum allowable change in target gradation on #200 sieve is 0.5 percent passing.
  4. No target change may violate mix design requirements.
- C. Non-Permeable Asphalt Pavement: Asphalt pavement that water will not penetrate through mix when water is placed on surface of pavement.
- D. Production Day: 24-hour period in which asphalt pavement is being placed.
- E. Screed: Any strike-off device operated by cutting, crowding or other practical action which is effective on mixture at workable temperature without tearing, shoving or gouging and which produces finished surface of evenness and texture specified.

#### 1.4 COORDINATION

- A. Prepare weekly schedule detailing construction activities planned for following week. Present schedule to RPR before Friday, 12:00 pm (noon) of preceding effective date of schedule. Weekly meetings may be required to review construction activities as indicated by ENGINEER.

#### 1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
1. Submit product information for asphalt and aggregate materials.
  2. Submit mix design with laboratory test results supporting design.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Mix design: Submit at least 10 days before paving begins.
1. Include test data used to develop mix design.
  2. Indicate single value for percentage of aggregate passing each sieve and asphalt cement content. Provide gradation within each band indicated.
- E. Changes to Mix Design: Submit in writing prior to production.
- F. Corrective action plan according to requirements of this Section.
- G. Weigh Tickets: Submit to ENGINEER at end of each workday. Keep duplicate copy of tickets.
- H. Sample: Provide sample to ENGINEER for calibration of burn off oven.

#### 1.6 QUALITY ASSURANCE

- A. Mixing Plant: Conform to NCDOT standards.

- B. Obtain materials from same source throughout.
- C. Perform Work in accordance with NCDOT standards.

## 1.7 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section listed on NCDOT approved list.

## 1.8 AMBIENT CONDITIONS/LIMITATIONS

- A. Section 015000 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.
- B. Do not place asphalt mixture between months specified in NCDOT Specifications/QMS Manual.
- C. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- D. Do not place asphalt pavement when base has free surface water, base is oversaturated, or frozen.
- E. Do not place asphalt pavement during adverse weather conditions such as precipitation. If precipitation begins during paving operations, OWNER assumes no responsibility for asphalt left in trucks when paving operation is halted due to precipitation.
- F. Use release agent that does not dissolve asphalt and is acceptable to ENGINEER for equipment and hand tools used to mix, haul, and place asphalt pavement.
- G. Provide and have ready for use at all times enough tarpaulins or covers in case of precipitation or other delay, for covering or protecting any material dumped but not spread.

## PART 2 - PRODUCTS

### 2.1 ASPHALT PAVING

- A. Performance / Design Criteria:
- B. Asphalt Materials:
  - 1. Asphalt Surface/Binder/Intermediate Courses: AASHTO M320; performance grade PG 64-22 in accordance with NCDOT Specifications/QMS Manual.
    - a. Type: As listed on the Plan Drawings.
    - b. Depth: As listed on the Plan Drawings.
  - 2. Warm Mix: In accordance with NCDOT standards.

3. Primer: In accordance with NCDOT standards.
  4. Tack Coat: In accordance with NCDOT standards.
  5. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt paving.
  6. Oil: In accordance with of NCDOT standards.
- C. Aggregate Materials:
1. Coarse Aggregate: In accordance with NCDOT standards.
  2. Fine Aggregate: In accordance with NCDOT standards.
  3. Mineral Filler: In accordance with NCDOT standards.
- D. Aggregate Subbase: Specified in Section 321123.

## 2.2 MIXES

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Asphalt Paving Mixtures: Designed in accordance with NCDOT standards. Maximum percent by weight of reclaimed asphalt pavement in accordance with NCDOT standards.
1. Base Course: Type and depth indicated on the Plan Drawings.
  2. Binder Course: Type and depth indicated on the Plan Drawings.
  3. Wearing Course: Type and depth indicated on the Plan Drawings, if applicable.

## 2.3 EQUIPMENT

- A. Asphalt Paver: Use self-propelled paver with screed capable of spreading mixture without segregation, placing to required grade, and confining mixture to true lines without use of stationary side forms. Paver must be equipped with acceptable automatic control system, which controls longitudinal grade and transfer slope, except when paving miscellaneous areas or when ENGINEER determines use of automatic control system is impractical. Use pick up conveyor or shuttle buggy to transfer asphalt mix from windrow to paver.
- B. Asphaltic Mixture Hauling Vehicles: Use trucks with tight clean and smooth boxes. End-Dump type vehicles are prohibited from dumping directly into paver.
- C. Rollers: Use rubber tire and steel self-propelled rollers in sufficient number to keep up with paver. Use release agent other than diesel. Use tandem rollers of 8- or 10-ton model weighing not less than 250 pounds per inch width of roller tread. Provide sufficient number and weight of rollers to compact mixture to required density while still in workable condition. Slurries used for surface repair contain fine aggregate. Type 1 is finest mix designed to penetrate surface cracks. Type 3 is coarsest used to build new wearing surface or to build crown. Use Type 2 to repair surface erosion and fill surface voids and build minimum wearing surface.



## 2.4 VOLUMETRIC DESIGN

- A. Perform Superpave Volumetric Mix Design according to NCDOT Standards and as follows:
  - 1. Determine optimum asphalt content by test data curves.
  - 2. Use test samples containing 0.5 percent increments of asphalt content.
  - 3. Include minimum of 2 test samples above and below optimum asphalt content.
- B. Mix Design Requirements:
  - 1. Hamburg Wheel Tracker: Maximum 10 mm impression at 20,000 passes.
  - 2. Number of Gyration:
    - a. N-initial = 7.
    - b. N-design = 75.
    - c. N-final = 115.
  - 3. Air Voids: 3 percent.
  - 4. Voids in Mineral Aggregate (VMA):
    - a. ¾ Inch Mix: 13.0% - 14%.
    - b. ½ Inch Mix: 14.0% - 15.0%.
    - c. 3/8 Inch Mix: 15.0% - 16.0%.
  - 5. Voids Filled with Asphalt (VFA): 70-80.
- C. If material source changes, develop new mix design prior to using new materials.
- D. Mix materials at central mixing plant. Use shortest mixing time needed to uniformly coat aggregate. Do not use material not mixed properly.
- E. Adjust production at mixing plant and delivery to maintain steady paving speed.
- F. Mix Design Changes:
  - 1. ENGINEER may allow up to two minor target changes per project without penalty to CONTRACTOR.

## 2.5 ACCESSORIES

- A. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.
- B. Sealant: In accordance with NCDOT standards.

## 2.6 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing, inspection and analysis requirements.
- B. Submit proposed mix design of each class of mix for review prior to beginning of Work.
- C. Test samples in accordance with in accordance with NCDOT standards.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- C. Verify compacted subgrade, granular stabilized soil and/or subbase is dry and ready to support paving and imposed loads.
  - 1. Proof roll subbase with 20-ton tandem axle dual wheel dump truck loaded to the legal limit with the tires inflated to 100 psi in minimum in two perpendicular passes to identify soft spots. Proof roll shall be done in the presence of the RPR or authorities having jurisdiction.
  - 2. Soft areas of the substrate that deflect more than 1 inch or show permanent deformations greater than 1 inch shall be removed and replaced with suitable materials or reworked to conform to the moisture content and compactions requirements in accordance with these specifications. Remove soft substrate and replace with compacted fill as specified in Section 312323..
- D. Verify gradients and elevations of base are correct. Do not place asphalt concrete pavement until base course has been accepted by ENGINEER.
- E. Verify gutter drainage, grates and frames, manhole lids and frames and other utilities are installed in correct position and elevation.
- F. If Project is located near signalized intersection, contact NCDOT Division Traffic Engineer to schedule field location of traffic signal conflicts. Notify ENGINEER of any potential conflict prior to construction. Coordinate conflict relocation with NCDOT during construction.

#### 3.2 PREPARATION

- A. Prepare subbase in accordance with NCDOT standards and these specifications.
- B. Do not start work until traffic control measures are in place.
- C. Locate and reference utility covers prior to paving operations.

#### 3.3 DEMOLITION

- A. Where new pavement joins existing pavement, saw cut edge of existing pavement. Provide saw cut through full depth of pavement and in straight line. If pavement is cracked, broken or deteriorated, make saw cut so defective area is removed. Properly dispose of pavement removed

by saw cutting. Remove dirt, sand, weeds, leaves, and other objectionable materials from prepared surfaces.

- B. Remove and dispose of existing portland cement concrete or asphalt pavement structure, including paved shoulders, within limits shown on Drawings or as indicated by ENGINEER. Remove and dispose of temporary roadway pavement structure placed for detours.
- C. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
- D. Where indicated, mill asphalt pavement in accordance with Section 607 of NCDOT Standards
- E. Where indicated, mill asphalt pavement in accordance with Section 607 of NCDOT Standards
- F. Repair surface defects in existing paving to provide uniform surface to receive new paving.

### 3.4 INSTALLATION

- A. Subbase:
  - 1. Prepare subbase in accordance with NCDOT standards and Section 321123.
- B. Primer:
  - 1. Apply primer in accordance with NCDOT standards.
  - 2. Use clean sand to blot excess primer.
- C. Tack Coat:
  - 1. Apply tack coat in accordance with NCDOT standards.
  - 2. Apply tack coat to contact surfaces of curbs, gutters and existing asphalt.
  - 3. Coat surfaces of manholes, catch basins and other utility frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.
- D. Single Course Asphalt Paving:
  - 1. Install Work in accordance with NCDOT standards.
  - 2. Place asphalt within 24 hours of applying primer or tack coat.
  - 3. Place asphalt wearing course to thickness indicated on Drawings.
  - 4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
  - 5. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.
- E. Double Course Asphalt Paving:
  - 1. Install Work in accordance with NCDOT standards.

2. Place asphalt binder course within 24 hours of applying primer or tack coat.
3. Place binder course to thickness indicated on Drawings.
4. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
5. Place wearing course to thickness indicated on Drawings.
6. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
7. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

F. Asphalt Paving Overlay

1. Apply tack coat to existing paving surface at rate recommended by geotextile fabric manufacturer.
2. Install Work in accordance with NCDOT standards.
3. Install geotextile fabric in accordance with manufacturer's instructions to permit asphalt saturation of fabric. Lap fabric edge and end joints 4 inches.
4. Place wearing course to thickness indicated on Drawings.

G. Compact overlay by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.

H. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

I. Curbs:

1. Install extruded asphalt curbs of as indicated on Drawings.

J. Joints:

1. Make in careful manner to provide well bonded and sealed joints.
2. Apply tack coat as indicated. If necessary, heat joint.
3. Offset longitudinal joints 6 to 12 inches in succeeding courses.
4. Place top course joint within one foot of roadway centerline or lane line.
5. Offset transverse construction joints at least 6 feet.
6. For roller breakdown pass on confined edge, keep 6 inches from confined edge on hot side of mat to ensure joint density.
7. For roller breakdown pass on unconfined edge, overlap unconfined edge at least 6 inches off of mat to prevent pavement from spreading.
8. Compact joint density to at least 90 percent of rice density.
9. Overlap screed onto previously placed mat  $\frac{3}{4}$  to 1 inch maximum.
10. Do not rake longitudinal joint.

K. Compaction:

1. Start rolling as soon as mixture will bear roller without undue misplacement or hairline cracking. Delays in rolling hand raked mixture will not be tolerated.
2. Operate rollers with competent, experienced operator and kept in continuous operation as nearly as practicable.

3. Start rolling longitudinally at outer edges and proceed toward center of pavement, overlapping on successive trips by at least one-half width of roller.
  4. Operate roller slow enough to avoid displacement mixture as a result of reversing. Correct any displacement immediately.
  5. Roll at rate not in excess of 500 square yards per hour per roller and continue until no further visible compaction is obtainable and roller marks have been eliminated.
  6. To prevent adhesion of mixture to roller, keep wheels moistened with water.
  7. In places not accessible to roller, compact thoroughly with hot tampers.
  8. Provide compaction and density control of asphalt in accordance with of Sections 609 and 610 of NCDOT Standards.
- L. Where exposed to traffic, taper end of course at approximately 50:1 (horizontal to vertical).
1. Remove portion of course that contains tapered end before placing fresh hot mix asphalt.
  2. Apply tack coat to contact surfaces of first course before fresh hot mix asphalt is placed against first course.
- M. Hand rake only when necessary.
- N. Set up exposed longitudinal edges of surface course by tamping with rake or lute at proper height and level to receive maximum compression under rolling.
- O. Place asphalt pavement to provide slope for drainage.
- P. Where indicated on Drawings, construct speed humps and/or raised crosswalks. Do not exceed maximum elevation indicated.
- Q. Utility Adjustments:
1. Adjust top of utility covers to match finish grade of asphalt pavement.
  2. Do not raise manhole or valve boxes for more than 14 days prior to resurfacing street.
  3. Immediately after making utility adjustment, paint sides of utility bright orange. Where necessary, place reflective orange traffic cones with 36-inch minimum height on utility.
  4. Notify OWNER if any broken manhole ring and cover, or valve boxes are discovered.

### 3.5 PAVEMENT REPAIR PATCH

- A. Where necessary to open cut along or across streets with asphalt surfaces, replace pavement with asphalt concrete intermediate course and asphalt concrete surface course to thickness indicated on Drawings.
- B. Extend replacement of base and asphalt pavement minimum of 1 foot on each side of excavated opening. Provide replacement material thickness sufficient to provide base and asphalt pavement of equivalent strength to undisturbed base and asphalt pavement.
- C. Meet applicable material and installation requirements.

### 3.6 CEASE PRODUCTION

- A. Cease production when any two out of three consecutive lots meet one of the following criteria:
  - 1. Air voids at N-design averaged for each lot are less than 2.5 or greater than 4.75 percent.
  - 2. VMA at N-design averaged for each lot are not within plus or minus 1.25 percent of target value.
- B. Submit corrective action plan to ENGINEER before production continues indicating changes in production procedures that will be implemented to correct deficiencies. Address specific issues contributing to cease production directive. Submit for ENGINEER to review and accept revised plan before production continues.
- C. ENGINEER may require new mix design.
- D. ENGINEER may require Hamburg Wheel-Track testing for up to 5 lots after cease production order at no additional expense to OWNER.
  - 1. ENGINEER will take random sample at location behind paver for up to 5 lots after cease production order.
  - 2. Failure to meet mix design requirements will result in rejection of lot.

### 3.7 TOLERANCES

- A. Smoothness: Maximum variation of 1/4 inch measured longitudinally, transversely, and at construction joints with 10-foot straight edge or string line. Correct depressions or humps exceeding tolerances.
- B. Compacted Thickness:
  - 1. OWNER accepts lot for thickness when:
    - a. Average thickness of all sublots is not more than 1/2 inch greater, or 1/4 inch less than total thickness specified.
    - b. No individual sublot shows deficient thickness of more than 3/8 inch.
  - 2. Thickness:
    - a. Excess Thickness: ENGINEER may allow excess thickness to remain in place or may order excess thickness to be removed.
    - b. Deficient Thickness: Place additional material where lots or sublots are deficient in thickness.
- C. Variation from Indicated Elevation: Within 1/2 inch.
- D. Elevation Difference between Top of Asphalt Pavement and Gutter: Maximum 1.0 inch. Remove and replace asphalt pavement, or remedy as indicated by ENGINEER at no cost to OWNER.

### 3.8 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting, testing.

- B. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Take samples and perform tests including asphalt paving thickness and mat density tests in accordance with NCDOT standards.
- D. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

### 3.9 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not allow traffic to cross saw cut edge of existing pavement unless temporary ramp is constructed.
- C. Protect structures, and other objects from being spattered or marred by tack coat.
- D. Do not allow construction vehicles, general traffic, or rollers to pass over uncompacted end or edge of freshly placed mix until mat temperature drops to point where damage or differential compaction will not occur.
- E. Where necessary, protect pavement edges by placing planks of same thickness as pavement adjacent to longitudinal or transverse joints until surface course is completed.
- F. Immediately after placement, protect paving from mechanical injury for 3 hours or until surface temperature is less than 140 degrees F.

END OF SECTION 321216





## SECTION 321313 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Aggregate subbase and base course.
2. Concrete paving for:
  - a. Concrete sidewalks.
  - b. Concrete stair steps.
  - c. Concrete integral curbs and gutters.
  - d. Concrete median barriers.
  - e. Concrete parking areas and roads.

#### 1.2 REFERENCE STANDARDS

##### A. ASTM International:

1. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
2. ASTM A775/A775M - S Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
3. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
4. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
5. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
6. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
7. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
8. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
9. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
13. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
14. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
15. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.

16. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

- B. North Carolina Department of Transportation (NCDOT):
  1. NCDOT Standard Specifications for Roads and Structures (NCDOT Specifications):

### 1.3 PRE-INSTALLATION MEETINGS

- A. Section 013000 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
  1. Submit data on concrete materials, joint filler, admixtures, and curing compounds.
- C. Design Data:
  1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
    - a. Hot and cold weather concrete work.
  2. Identify mix ingredients and proportions, including admixtures.
- D. Source Quality Control Submittals: Indicate results of tests and inspections.

### 1.5 QUALITY ASSURANCE

- A. Obtain cementitious materials from same source throughout.
- B. Perform Work according to NCDOT and Municipal of standards.

### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products and listed on NCDOT's approved supplier list.
- B. Installer: Company specializing in performing work of this section and listed on NCDOT's approved installer list.

1.7 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.
- B. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 AGGREGATE SUBBASE and BASE COURSE

- A. Aggregate Subbase and Base Course: As specified in Section 321123.

2.2 CONCRETE PAVING

A. Form Materials:

- 1. Form Materials: As specified in Section 031000.
- 2. Joint Filler: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/4 inch thick.

B. Reinforcement:

- 1. Reinforcing Steel and Wire Fabric: Type specified in Section 032000 or as indicated on the Plan Drawings.

C. Concrete Materials:

- 1. Concrete Materials: As specified in Section 033000. Provide according to NCDOT of standards.
- 2. Water: ASTM C94/C94M; potable,.
- 3. Air Entrainment: ASTM C260.
- 4. Chemical Admixture: ASTM C494/C494M. Use a quantity of chemical admixture within the range shown on the current list of approved admixtures issued by the Materials and Test Unit of NCDOT.
  - a. Type A - Water Reducing.
  - b. Type B - Retarding.
  - c. Type C - Accelerating.
  - d. Type D - Water Reducing and Retarding.
  - e. Type E - Water Reducing and Accelerating.
  - f. Type F - Water Reducing, High Range.
  - g. Type G - Water Reducing, High Range and Retarding.
- 5. Fly Ash: In accordance with NCDOT standards.
- 6. Slag: In accordance with NCDOT standards.

7. Plasticizing: ASTM C1017/C1017M Type I, plasticizing or Type II, plasticizing and retarding.
8. Color Pigment: ASTM C979; mineral oxides, alkali and fade resistant.
  - a. Color: As directed by the ENGINEER and OWNER.

## 2.3 FABRICATION

- A. Fabricate reinforcing according to NCDOT standards.
- B. Form standard hooks for 180-degree bends, 90-degree bend, and seismic hooks as indicated on Drawings.

## 2.4 MIXES

- A. Concrete Mix:
  1. Select proportions for normal weight concrete according to NCDOT standards.
  2. Provide concrete compressive strength, slump, minimum cement content and air entrainment in accordance with NCDOT Standard Specifications for Roads and Structures, latest edition, Section 1000. .
  3. Limit the following cementitious materials to maximum percentage by mass of all cementitious materials:
    - a. Fly Ash: In accordance with NCDOT standards..
    - b. Blast Furnace Slag: In accordance with NCDOT standards..
    - c. Fly Ash and Blast Furnace Slag: In accordance with NCDOT standards..
  4. Use accelerating admixtures in cold weather only when approved by the ENGINEER in writing. Use of admixtures will not relax cold weather placement requirements.
  5. Use calcium chloride only when approved by the ENGINEER in writing.
  6. Use set retarding admixtures during hot weather only when approved by the ENGINEER in writing.

## 2.5 FINISHES

- A. Shop Finishing - Reinforcement:
  1. Galvanized Finish for Steel Bars: ASTM A767/A767M, Class I, hot dip galvanized after fabrication.
  2. Epoxy Coated Finish for Steel Bars: ASTM A775/A775M.
- B. Epoxy Coated Finish for Steel Wire: ASTM A884/A884M; Class A, using ASTM A775/A775M.

## 2.6 ACCESSORIES

- A. Curing Compounds: In accordance with NCDOT standards..
- B. Liquid Surface Sealer: In accordance with NCDOT standards..
- C. Surface Retarder: In accordance with NCDOT standards..
- D. Joint Sealers: Specified in Section 079000.

## 2.7 SOURCE QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Testing and Inspection Services:
- B. Submit proposed mix design of each class of concrete to ENGINEER for review prior to commencement of Work.
- C. Tests on cement, aggregates, and mixes shall be performed to ensure conformance with specified requirements.
- D. Test samples according to ASTM C94/C94M

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify compacted subbase, subgrade, granular fill, or stabilized soil is dry and ready to support paving and imposed loads.
  - 1. Proof roll subbase, subgrade, granular fill, or stabilized soil with 20-ton tandem axle dual wheel dump truck loaded to the legal limit with the tires inflated to 100 psi in minimum in two perpendicular passes to identify soft spots. Proof roll shall be done in the presence of the RPR or authorities having jurisdiction.
  - 2. Soft areas of the subbase, subgrade, granular fill, or stabilized soil that deflect more than 1 inch or show permanent deformations greater than 1 inch shall be removed and replaced with suitable materials or reworked to conform to the moisture content and compactions requirements in accordance with these specifications. Remove soft subbase, subgrade, granular fill, or stabilized soil and replace with compacted fill as specified in Section 312323.
  - 3.
- C. Verify gradients and elevations of base are correct.

### 3.2 PREPARATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Moisten substrate to minimize absorption of water from fresh concrete.
- C. Coat surfaces of utility structure frames with oil to prevent bond with concrete paving.
- D. Notify ENGINEER minimum 24 hours prior to commencement of concreting operations.

### 3.3 INSTALLATION

- A. Subbase and Base Course:
  - 1. Aggregate Subbase and Base Course: Install as specified in Section 321123.
- B. Forms:
  - 1. Place and secure forms and screeds to correct location, dimension, profile, and gradient.
  - 2. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Reinforcement:
  - 1. Place reinforcing as indicated on Drawings.
  - 2. Interrupt reinforcing at contraction and expansion joints.
  - 3. Place dowels and reinforcing to achieve paving and curb alignment as detailed.
  - 4. Provide doweled joints as indicated on the Drawings.
  - 5. Repair damaged galvanizing to match shop finish.
- D. Placing Concrete:
  - 1. Coordinate installation of snow melting components.
  - 2. Place concrete as specified in Section 033000.
  - 3. Ensure reinforcing, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
  - 4. Place concrete continuously over the full width of the panel and between predetermined construction joints.
  - 5. Place concrete to pattern indicated.
- E. Joints
  - 1. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.
  - 2. Seal joints as indicated on Drawings according to Section 079000.
- F. Exposed Aggregate:
  - 1. Apply surface retarder where exposed aggregate finish is required.

2. Wash exposed aggregate surface with clean water and scrub with stiff bristle brush exposing aggregate to match plan requirements..

G. Finishing:

1. Area Paving: Wood float.
2. Sidewalk Paving: Light broom radius, and trowel joint edges.
3. Median Barrier: Light broom radius, and trowel joint edges.
4. Curbs and Gutters: Light broom.
5. Direction of Texturing: Transverse to paving direction.
6. Inclined Vehicular Ramps: Broomed perpendicular to slope.
7. Place curing compound on exposed concrete surfaces immediately after finishing.

H. Curing and Protection

1. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
2. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
3. Cure concrete floor surfaces as specified in Section 033900.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Tolerances.
- B. Maximum Variation of Surface Flatness: 1/4 inch
- C. Maximum Variation From True Position: 1/4 inch.

3.5 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Perform field inspection and testing according to ASTM C94/C94M and NCDOT of standards.
- D. Inspect reinforcing placement for size, spacing, location, support.
- E. Testing firm shall take cylinders and perform slump and air entrainment tests according to NCDOT standards.
- F. Strength Test Samples:
  1. Sampling Procedures: ASTM C172.

2. Cylinder Molding and Curing Procedures: ASTM C31/C31M, cylinder specimens, standard cured.
3. Sample concrete and make one set of five cylinders for every 75 cu yds or less of each class of concrete placed each day and for every 5,000 sf of surface area paving.

G. Field Testing:

1. Slump Test Method: ASTM C143/C143M.
2. Air Content Test Method: ASTM C173/C173M.
3. Temperature Test Method: ASTM C1064/C1064M.
4. Measure slump and temperature for each compressive strength concrete sample.
5. Measure air content in air entrained concrete for each compressive strength concrete sample.

H. Cylinder Compressive Strength Testing:

1. Test Method: ASTM C39/C39M.
2. Test Acceptance: according to NCDOT standards.
3. Test cylinders in accordance with NCDOT standards.
4. Retain one cylinder for 56 days for testing when requested by ENGINEER.
5. Dispose remaining cylinders when testing is not required.

- I. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

3.6 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Immediately after placement, protect paving from premature drying, excessive hot or cold temperatures, and mechanical injury.
- C. Do not permit pedestrian or vehicular traffic over paving until accepted by ENGINEER.

END OF SECTION 321313



## SECTION 321343 – PERVIOUS CONCRETE PAVING

### PART 1 GENERAL

#### 1.01. THE REQUIREMENT

- A. Furnish all labor, equipment, and materials and perform all operations in connection with the construction of pervious concrete pavement, and pavement markings complete as specified herein and as detailed on the Drawings.
- B. All new areas including the replacement of portions of the existing roads shall be to the limits, grades, thicknesses and types as shown on the Drawings.
  - 1. Patches for pipe crossings and areas damaged during the construction work shall be asphalt and/or gravel, depending upon the material encountered, unless otherwise indicated.

#### 1.02. SUMMARY

##### A. Description

- 1. The work of this Section includes subgrade preparation and installation of Portland Cement Pervious Pavement.

##### B. Related Sections

- 1. Section 01300 – Submittals
- 2. Section 02225 – Excavation, Backfilling and Compacting
- 3. Section 02233 – Aggregate Base Course
- 4. Section 03300 – Cast-in-Place Concrete

##### C. Measurement

- 1. Portland cement concrete pervious pavement, by square foot OR square yard, of the depth specified, placed to the lines and grades shown on the Contract Drawings.
- 2. No measurement will be made for:
  - a. Extra thickness of pervious pavement, as discovered in the field through testing.
  - b. Cutting concrete joints, joint materials, and/or joint sealant, used in the construction of Portland cement pervious concrete pavements.

##### D. Payment

- 1. Portland Cement Pervious Concrete Pavement will be paid for per square foot OR square yard of the depth and type specified, which price will be payment in full for furnishing all labor, materials, tools, equipment and incidentals, and doing all Work necessary to complete the Portland cement pervious concrete pavement, as specified, including: Furnishing and installing curing materials, cutting concrete joints (sawcut or plastic), thickened edges of concrete at joints if specified, joint material, joint sealant (if specified), used in construction of Portland cement pervious concrete pavement.

1.03. REFERENCES

- A. Annual Book of ASTM Standards, 1997; American Society for Testing and Materials, Philadelphia, PA.
- B. Standards of the American Association of State Highway and Transportation Officials (AASHTO).
- C. American Society of Testing and Materials ASTM C 29 “Test for Unit Weight and Voids in Aggregate.”
- D. American Concrete Institute (ACI) 522.1-08 “Specification for Pervious Concrete Pavements.”
- E. American Concrete Institute (ACI) 306R – latest edition “Cold Weather Concreting.”
- F. ASTM C 33 “Specification for Concrete Aggregates.” ASTM C 42 “Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- G. ASTM C 117 “Test Method for Material Finer than 75  $\mu\text{m}$  (No. 200) Sieve in Mineral Aggregates by Washing.”
- H. ASTM C 140 “Methods of Sampling and Testing Concrete Masonry Units.”
- I. ASTM C 150 “Specifications for Portland Cement” (Types I or II only).
- J. ASTM C 172 “Practice for Sampling Fresh Concrete.”
- K. ASTM C 260 “Specification for Air-Entraining Admixtures for Concrete.”
- L. ASTM E 329 “Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as used in Construction.”
- M. ASTM D 448 “Specification for Standard Sizes of coarse Aggregate for Highway Construction.
- N. ASTM C 494 “Specification for Chemical Admixtures for Concrete.”
- O. ASTM C 595 “Specifications for Blended Hydraulic Cements” (Types IP or IS only).
- P. ASTM C 618 “Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.”
- Q. ASTM C 989 “Specification for Ground Granulated Blast-Furnace Slag for use in Concrete and Mortars.”
- R. ASTM C 1077 “Practice for Laboratories Testing Concrete and concrete Aggregates for use in Construction and Criteria Laboratory Evaluation.”
- S. ASTM C1116 “Standard Specification for Fiber Reinforced Concrete”
- T. ASTM D 1557 “Tests for Moisture-Density Relations of Soils and Soil Aggregate Mixtures using 10 Pound Rammer and 18-inch Drop”
- U. ASTM C 1688 “Standard Test Method for Density and Void Content of Freshly Mixed Pervious Concrete.”
- V. ASTM C 1701 “Standard Test Method for Infiltration Rate of In Place Pervious Concrete.”

W. ASTM C1754 / C1754M - 12 "Standard Test Method for Density and Void Content of Hardened Pervious Concrete."

1.04. SUBMITTALS

- A. See Section 01300- Administrative Requirements, for submittal procedures.
- B. Concrete Mix Design
- C. NRMCA Certifications of the contractor and ready mixed concrete producer as described in section 1.06 below.

1.05. QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 522 except as modified herein.
- B. Follow recommendations of ACI 306R when concreting during cold weather with the exception of the following:
  - 1. Do not place pervious concrete unless the temperature is above 32 degrees F for seven (7) consecutive calendar days, unless otherwise permitted in writing by the Engineer.
- C. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

1.06. CONTRACTOR QUALIFICATIONS

- A. The Contractor shall employ no less than one National Ready Mixed Concrete Association (NRMCA) Certified Pervious Concrete Craftsman who must be on site, overseeing each placement crew during all concrete placement, or the Contractor shall employ no less than three (3) NRMCA Certified Pervious Concrete Installers, who shall be on site working as members of each placement crew during all concrete placement unless otherwise specified. Alternative documentation of qualifications shall be permitted when approved by the Architect/Engineer. Prior to award of the contract, the placing contractor shall furnish Owner/Engineer a statement attesting to qualifications and experience and the following:
  - 1. A minimum of 3 completed projects, total square footage to exceed 10,000 SF with addresses.
  - 2. Unit weight acceptance data.
  - 3. In-Situ pavement test results including void content and unit weight.
  - 4. Sample of Product (i.e. core or test panel)
- B. If the placing contractor and concrete producer have insufficient experience with Portland Cement pervious concrete pavement (less than 3 successful jobs), the placing contractor shall either:
  - 1. Retain an experienced consultant or NRMCA Certified Pervious Craftsman to monitor production, handling, and placement operations at the contractor's expense, or
  - 2. Receive permission in writing from the Engineer or Owner of the acceptance of the contractor's experience on past projects as sufficient.

3. The Owner and/or Contractor may contact the NRMCA for information on qualified/NRMCA certified contractors and personnel. Contact Shawnita Dickens, sdickens@nrmca.org, 703-706-4854.
  - C. Test Panels: Regardless of qualification, Contractor is to place, joint and cure two test panels, each to be a minimum of 200 sq. ft. at the required project thickness to demonstrate to the Architect's and Owner's satisfaction that in-place unit weights can be achieved and a satisfactory pavement can be installed at the site location.
  - D. Test panels may be placed at any of the specified Portland Cement pervious locations on the project or at another test site. Test panels shall be tested for thickness in accordance with ASTM C 42; and void structure and unit weight in accordance with ASTM C 1688.
  - E. Satisfactory performance of the test panels will be determined by:
    1. Compacted thickness no less than 1/4" of specified thickness.
    2. Void Structure: 15% minimum; 23% maximum.
    3. Unit weight plus or minus 5 pcf of the design unit weight.
    4. If measured void structure falls below 13% or if measured thickness is greater than 1/4" less than the specified thickness or if measured weight falls less than 5 pcf below unit weight, the test panel shall be removed at the contractor's expense and disposed of in an approved landfill.
  - F. If the test panel meets the above-mentioned requirements, it can be left in-place and included in the completed work.
- 1.07. PROJECT CONDITIONS
- A. Protection of Existing Improvements
    1. Protect adjacent work from splashing of paving materials. Remove all stains from exposed surfaces of paving, structures, and grounds. Remove all waste and spillage.
    2. Do not damage or disturb existing improvements or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work.
    3. Restore damaged improvements, including existing paving on or adjacent to the site that has been damaged as a result of construction work, to their original condition or repair as directed to the satisfaction of the Owner, and authority having jurisdiction at no additional cost.
  - B. Safety and Traffic Control
    1. Notify and cooperate with local authorities and other organizations having Jurisdiction when construction work will interfere with existing roads and traffic.
    2. Provide temporary barriers, signs, warning lights, flagmen, and other protections as required to assure the safety of persons and vehicles around the construction area and to organize the smooth flow of traffic. Costs for said traffic control are to be included in the price of installation of the Pervious Concrete.
  - C. Weather Limitations

1. Follow recommendations of ACI 522 when concreting during cold weather with the exception of the following: Do not place pervious concrete unless the temperature is above 32 degrees F for seven (7) consecutive calendar days, unless otherwise permitted in writing by the Engineer.

1.08. PRE PAVING CONFERENCE

A pre-paving conference with the engineer shall be held two (2) days prior to beginning placing the pervious concrete. The contractor shall have the pervious concrete consultant, ready mix supplier, the foreman and the entire concrete crew that will form and place the concrete in attendance at this meeting.

PART 2 PRODUCTS

2.01. CONCRETE MIX DESIGN

Contractor shall furnish a proposed mix design with proportions of materials prior to commencement of work. **The data shall include void content and unit weight as determined in accordance with ASTM C 1688.**

2.02. STORMWATER STORAGE/INFILTRATION BEDS

- A. Coarse aggregates shall meet the size and grading requirements as defined in Standard Sizes of Coarse Aggregate, Table 4, AASHTO Specifications, Part I, 13<sup>th</sup> Ed., 1982, or later, unless otherwise specified.
- B. Coarse aggregate for groundwater recharge bed shall be between 2-1/2" to 3/4", uniformly graded crushed coarse aggregate, with a wash loss of no more than 0.5%, AASHTO size number 2 thru 57 per Table 4, AASHTO Specifications, Part I, 13<sup>th</sup> Ed., 1982, or later.
- C. Use only one selected size of stone – multiple layers of different sized stones (such as a choker course) is not required for pervious concrete.
- D. Non-woven filter fabric shall be Propex PERC™ Pervious Concrete Infiltration Fabric or approved equal.
- E. Impervious liner – shall be Permalon, PLY-X 150, or approved equal.

2.03. PORTLAND CEMENT PERVIOUS CONCRETE

- A. Cement: Portland Cement Type I or II conforming to ASTM C 150 or Portland Cement Type IP or IS conforming to ASTM C 595. Ground Granulated Blast Furnace Slag, Flyash, or Silica Fume may be used as part of the total cementitious content.
- B. Aggregate:
  1. For most applications (parking lots, driveways, sidewalks), use 3/8" washed, crushed coarse aggregate with a minimum void content per ASTM C29 of 40%.
  2. For sidewalks and trails, an optional size of aggregate may be used, #9 (1/4") washed, crushed coarse aggregate with a minimum void content per ASTM C29 of 40%.
  3. Industrial/heavy duty pavements where ADA requirements are not needed, use #57 (3/4") or larger, washed, crushed coarse aggregate with a minimum void content per ASTM C29 of 40%.
  4. If other gradations of aggregate are to be used, submit data on proposed material to owner for approval.

C. Admixtures and Reinforcement: The following admixtures may be used as needed:

1. A hydration stabilizer that meets the requirements of ASTM C 494 Type B Retarding or Type D Water Reducing/Retarding admixtures. This stabilizer suspends cement hydration by forming a protective barrier around the cementitious particles, which delays the particles initial set.
2. Air Entraining Agent – ASTM C 260 may be used to improve resistance to freeze/thaw cycles.
3. A viscosity modifier - Used to reduce paste drain down caused by using a dirty aggregate
4. Synthetic fibers per ASTM C1116 - Standard Specification for Fiber Reinforced Concrete, if specified, either:
  - a. Monofilament polypropylene / polyethylene blend dosed at the rate of 2 to 3 pounds per cubic yard
    - 1) Specific Gravity 0.92
    - 2) Fiber Length 2"
    - 3) Tensile Strength 87-94 ksi (600-650 MPa)
    - 4) Modulus of Elasticity 725 ksi (5.0 GPa)
    - 5) Aspect Ratio 74
  - b. Cellulose fibers dosed at the rate of 3 pounds per cubic yard

D. Water: Potable water shall be used. DO NOT USE HOT WATER IN PERVIOUS CONCRETE.

E. Proportions:

1. Cement Content: For pavements subjected to vehicular traffic loading, the total cementitious material shall be within the range of 450 to 550 lbs. per cu. yd. For other pavement areas not subject to vehicular traffic loading, the total cementitious material shall be in the range of 450 to 500 lbs. per cu. yd.
2. Aggregate Content: the volume of aggregate per cu. yd. shall be equal to 27 cu. ft. when calculated as a function of the unit weight determined in accordance with ASTM C 1688.
  - a. An aggregate/cement ratio range of 4:1 to 4.5:1.
  - b. A unit weight range of 105 lbs/cu. ft. to 140 lbs/cu. ft. per ASTM C 1688.
  - c. Voids of 15% to 23%.
3. Admixtures: Shall be used in accordance with the manufacturer's instructions and recommendations.
4. Mix Water: Mix water shall be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. (Mix water yielding a cement paste with a dull-dry appearance has insufficient water for hydration).
  - a. **Water cement ratios should range from 0.30 to 0.36.**

- b. Insufficient water results in inconsistency in the mix and poor bond strength.
- c. High water content results in the paste sealing the void system primarily at the bottom and poor surface bond.

### PART 3 EXECUTION

OWNER SHALL BE NOTIFIED AT LEAST 24 HOURS PRIOR TO ALL RECHARGE BED AND PERVIOUS PAVING WORK.

#### 3.01. **INSTALLATION**

##### A. Subgrade Preparation

1. Existing subgrade under bed areas shall **NOT** be compacted or subject to excessive construction equipment traffic prior to stone bed placement.
2. Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, this material shall be removed with light equipment and the underlying soils scarified to a minimum depth of 6 inches with a York rake or equivalent and light tractor.
3. Bring subgrade of stone recharge bed to line, grade, and elevations required.
4. Fill and lightly regrade any areas damaged by erosion, ponding, or traffic compaction before the placing of stone.

##### B. Recharge Bed Installation

1. Upon completion of subgrade work, the Engineer shall be notified and shall inspect at his discretion before proceeding with recharge bed installation.
2. Filter fabric, pipe, and recharge bed aggregate shall be placed immediately after approval of subgrade preparation. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of filter fabric at no extra cost to the Owner.
3. Place filter fabric in accordance with manufacturer's standards and recommendations. Adjacent strips of filter fabric shall overlap a minimum of sixteen inches (16"). Secure fabric at least two feet (2') outside of bed and take steps necessary to prevent any runoff or sediment from entering the storage bed.
4. If an impervious liner is specified, place impervious liner over geo-textile extending six feet (6') beyond toe of slope face at building face, secure as recommended by manufacturer.
5. Install coarse aggregate in 6 inch maximum lifts. Lightly compact each layer with equipment, keeping equipment movement over storage bed subgrades to a minimum.
6. Install aggregate to grades required on the drawings.
7. Following placement of bed aggregate, the filter fabric shall be folded back along all bed edges to protect from sediment washout along bed edges. At least a two foot (2") strip shall be used to protect beds from adjacent bare soil. This edge strip shall remain in place until all bare soils contiguous to beds are stabilized and vegetated. In addition, hay bales shall be placed at the toe of slopes which may be adjacent to beds to further

prevent sediment from washing into beds during site development. As the site is fully stabilized, excess filter fabric along the bed edges can be cut back to gravel edge.

3.02. PORTLAND CEMENT PERVIOUS PAVEMENT CONCRETE MIXING, HAULING AND PLACING

- A. Mix Time: Central mixed concrete shall be mixed for a minimum of two (2) minutes after introduction of all materials into mixer. Truck mixers shall be operated at the speed designated as mixing speed by the manufacturer for 75 to 100 revolutions (or 3 to 5 minutes) of the drum.
- B. Transportation: The Portland Cement aggregate mixture may be transported by ready mix trucks or dump trucks or mixed on site and should be used within one (1) hour of the introduction of mix water, unless otherwise approved by an engineer. This time can be increased to 120 minutes when utilizing the hydration stabilizer specified above at the proper dosage rate, unless otherwise approved by an engineer.
- C. Each truck should not haul more than two (2) loads before being cycled to another type concrete, unless delivered by dump truck or if a stabilizing hydration agent is used in the pervious concrete mix design or if field experience proves that there is no significant concrete buildup in concrete mixer after delivery.
- D. Prior to placing concrete, the subbase shall be soaked and in a wet condition (no ponding of water) at time of placement. Failure to provide a moist subbase will result in a reduction in strength of the pavement.
- E. Discharge shall be a continuous operation and shall be completed as quickly as possible. If consolidation occurs during concrete discharge, placement shall be halted and wet concrete removed.
- F. Concrete shall be deposited as close to its final position as practicable and such that fresh concrete enters the mass of previously placed concrete.
- G. Placing and Finishing Equipment: Unless otherwise approved by the Owner or Engineer in writing, the Contractor shall provide mechanical equipment of either slipform or form riding with a following compactive unit that will provide a minimum of 10 psi vertical force.
- H. The pervious concrete pavement will be placed to the required cross section and shall not deviate more than +/- 3/8 inch in 10 feet from profile grade.
- I. If placing equipment does not provide the minimum specified vertical force, a full width roller or other full width compaction device that provides sufficient compactive effort shall be used immediately following the strike-off operation.
- J. Strike off the pervious concrete 1/2" to 3/4" above the final grade prior to compaction, if needed, by using either slip-form, form riding vibrating screed, form riding aluminum roller screed or laser screed. Strike off may be done by hand for sidewalks. Care must be taken to avoid filling voids in the concrete.
- K. The Contractor will be restricted to pavement placement widths of a maximum of fifteen (15') feet unless the Contractor can demonstrate competence to provide pavement placement widths greater than the maximum specified to the satisfaction of the Owner.



### 3.03. CURING

- A. Curing procedures shall be complete within 20 minutes after the final placement operations if polyethylene sheeting is used.
  - 1. The pavement surface must be covered with a layer of six (6) mil thick polyethylene sheeting.
    - a. PRIOR TO THE ARRIVAL OF THE CONCRETE, remove the plastic sheeting from the box, unfold, measure, and cut to size. Roll the plastic onto a PVC pipe that is of sufficient length to span the forms.
    - b. Plastic can now be rolled onto the finished pavement in an efficient manner.
  - 2. On hot weather days, the pavement surface shall be covered with a minimum .20 mil thick polyethylene sheet (painters plastic) or other approved covering material prior to final cross rolling of the surface and then covered with a layer of four to six (4 – 6) mil thick polyethylene sheeting. Prior to covering, an evaporative reducer shall be sprayed above the surface when required due to ambient conditions (high temperature, high wind, and low humidity).
- B. The cover shall overlap by 18 inches all exposed edges and shall be secured (without using dirt or stone) to prevent dislocation due to winds or adjacent traffic conditions.
  - 1. Secure plastic to forms with staples or nails.
  - 2. Overlap plastic sheeting as roof tiles to prevent rainwater from infiltrating the pervious concrete until it has sufficiently cured.
  - 3. Prevent wind from billowing up the middle of the plastic by placing wood 2"x4" or rebar across the plastic spanning the form.
- C. Cure Time: **7 days minimum.**
- D. No truck traffic shall be allowed for **10 days**; no passenger car/light trucks for **7 days**; and no pedestrian traffic for **48 hours**.

### 3.04. JOINTING

- A. Control (contraction) joints shall be installed as indicated by plans. They shall be installed at a depth of the 1/3 to 1/4 the thickness of the pavement.
- B. These joints are to be saw cut.
- C. For saw cuts, the procedure should begin as soon as the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking (normally after curing), minimum of 36 hours after placement.
- D. Possible complications from saw cutting include:
  - 1. Removal of plastic to perform saw cutting will cause pervious concrete to hydrate too quickly. If plastic is removed to accommodate saw cutting, re-hydrating of pervious concrete by spraying concrete with water and keep concrete wet until plastic can be reapplied. **THIS IS REQUIRED.**
  - 2. Sawing pervious concrete too early can damage concrete surface.

- E. Transverse constructions joints shall be installed whenever placing is suspended a sufficient length of time that concrete may begin to harden (over 20 minutes).
  - F. Isolation (expansion) joints should be used in structure widths exceeding thirty (30) feet or at seventy five (75) feet on sidewalks or when pavement is abutting slabs or other adjoining structures.
  - G. Expansion joint material shall be K-form screed rail or approved equal.
  - H. To reduce raveling, if transverse or isolation joints are used, or where pervious concrete meets impervious pavement, extra compaction may be necessary.
  - I. Additional installation specifications for the pervious concrete provided by the material source and engineer shall be followed strictly.
- 3.05. PERVIOUS PAVEMENT CONCRETE TESTING, INSPECTION, AND ACCEPTANCE
- A. The owner will retain an independent testing laboratory.
  - B. The testing laboratory shall conform to the applicable requirements of ASTM E 329 “Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction” and ASTM C 1077 “Standard Practice for Testing Concrete and Concrete Aggregates for use in Construction, and Criteria for Laboratory Evaluation” and shall be inspected and accredited by the Construction Materials Engineering Council, Inc. or by an equivalent recognized national authority.
  - C. The Agent of the testing laboratory performing field sampling and testing of concrete shall be certified by the American Concrete Institute as a Concrete Field Testing Technician Grade I, or by a recognized state or national authority for an equivalent level of competence.
  - D. Testing and Acceptance:
    - 1. A minimum of 1 gradation test of the subgrade is required every 5,000 square feet to determine percent passing the No. 200 sieve per ASTM C 117.
    - 2. A minimum of one test for each load of pervious concrete in accordance with ASTM C 1688 to verify unit weight shall be conducted. Delivered unit weights are to be determined in accordance with ASTM C 1688 using a 0.25 cubic foot cylindrical metal measure. The measure is to be filled and compacted in accordance with ASTM C 1688. The unit weight of the delivered concrete shall be +/- 5 pcf of the design unit weight.
    - 3. Test panels shall have two cores taken from each panel in accordance to ASTM C 42 at a minimum of seven (7) days after placement of the pervious concrete. The cores shall be measured for thickness, void content and unit weight in accordance with ASTM C1754. Range of satisfactory unit weight values are +/- 5% pcf of the design unit weight.
    - 4. After a minimum of seven (7) days following each placement, three cores shall be taken in accordance with ASTM C 42. The cores shall be measured for thickness, void content and unit weight determined as described above for test panels. Core holes shall be filled with concrete meeting the pervious design or other concrete material as permitted by the owner.

- E. Maintenance: There shall be a maintenance plan submitted by the owner to prevent the clogging of the pervious concrete pavement which shall include periodic testing for flowability by the pervious concrete installer prior to the pervious concrete being opened to service, in accordance with ASTM C 1701 - Standard Test Method for Infiltration Rate of In Place Pervious Concrete, with flow rates reported in writing to the owner and again at six (6), twelve (12) eighteen (18) and twenty-four (24) months and again report the results in writing to the owner. It is the contractor's responsibility to help the owner to develop a maintenance plan. The owner must have a plan and methods to restore flowability if the flow rate drops below 75% of the original rate. Acceptable methods to restore levels of flowability are either to vacuum or power wash the pervious concrete sections. Owner may refer to *NRMCA Pervious Concrete Pavement Maintenance and Operations Guide* for assistance in developing and following an acceptable maintenance procedure.

END OF SECTION 321343



## SECTION 323113 - CHAIN LINK FENCES AND GATES

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to perform and complete the installation of chain link fences and gates in accordance with the plans. All materials, testing, and procedures shall be of the type specified herein.

##### B. Section Includes:

1. Fence framework, fabric, and accessories.
2. Excavation for post bases.
3. Concrete foundation for posts and center drops for gates.
4. Manual gates and related hardware.
5. Privacy slats.

#### 1.02. REFERENCES

##### A. ASTM International:

1. ASTM A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
6. ASTM A824 - Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link Fence.
7. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
8. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
9. ASTM F626 - Standard Specification for Fence Fittings.
10. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
11. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
12. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
13. ASTM F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.

B. Chain Link Fence Manufacturers Institute:

1. CLFMI - Product Manual.

1.03. SYSTEM DESCRIPTION

A. Fence Height: as indicated on Drawings.

B. Line Post Spacing: At intervals not exceeding 8 feet.

1. Fence Post and Rail Strength: Conform to ASTM F1043 Heavy Industrial Fence quality, Material Group IA

1.04. SUBMITTALS

A. Section 01 30 00 - Electronic Submittals.

B. Shop Drawings: Indicate plan layout, elevations, details, spacing of components, post foundation dimensions, hardware anchorage, gates, attachments to other work, and schedule of components. Show accessories, hardware, gate operation, and operational clearances.

C. Product Data: Submit data including material descriptions, dimensions of individual components and profiles, and finishes on:

1. Chain-link fabric, reinforcements, and attachments
2. Fence and gate posts, rails, and fittings.
3. Accessories: Barbed wire and angle brackets
4. Fittings
5. Gates and hardware.
6. Gate operators, including operating instructions.
7. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.

D. Product Test Reports: For framing strength according to ASTM F1043.

E. Product Certificates: For each type of chain-link fence, and gate, from manufacturer.

F. Manufacturer's Installation Instructions: Submit installation requirements for metal fencing, fabric, gates, and accessories.

1.05. CLOSEOUT SUBMITTALS

A. Section 01 72 00 - Project Record Documents.

B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines and easements.

C. Operation and Maintenance Data: Provide emergency, operation, and maintenance manuals for gate hardware.

1.06. QUALITY ASSURANCE

A. Supply material according to CLFMI - Product Manual.

B. Provide chain link fence and gates as complete units controlled by a single source including necessary erection accessories, fittings, and fastenings.

- C. Fence shall be erected by skilled mechanics in accordance with the best practice of the trade and in accordance with the recommendations of the Chain Link Fence Manufacturers Institute and ASTM F567.
  - D. Where applicable, perform Work according to State of North Carolina Department of Transportation standards.
  - E. Engage a factory-authorized service representative to train OWNER's personnel to adjust, operate, and maintain chain-link fences and gates.
- 1.07. QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
  - B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.
  - C. Delegated Designer: Qualified professional ENGINEER will design chain-link fences and gates, including performing a comprehensive engineering analysis, using performance requirements and design criteria indicated.
- 1.08. DELIVERY, STORAGE AND HANDLING
- A. Section 01 55 00 - Site Access and Storage.
  - B. All materials shall be delivered, stored, and handled in strict accordance with the manufacturer's recommendations.
  - C. Deliver fence fabric and accessories in an undamaged condition in packed cartons or firmly tied rolls.
  - D. Identify each package with manufacturer's name.
  - E. Store fence fabric and accessories in secure and dry place off the ground to provide protection against oxidation caused by ground contact.
- 1.09. WARRANTY
- A. All material shall be warranted to be free from defects in workmanship and design for a period of one (1) year from the date of acceptance by the OWNER.

## PART 2 PRODUCTS

### 2.01. MATERIALS

- A. Performance and Design Criteria:
  - 1. Chain-link fence and gate framework shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7:
    - a. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified and on the following:
      - 1) Wind Loads: 90 miles per hour or local codes, whichever is greater.
      - 2) Exposure Category: B.

- B. Framing (Steel): ASTM F1083 Schedule 40 galvanized steel pipe, welded construction, minimum yield strength of 25 ksi; coating conforming to ASTM F1043 Type A on pipe exterior and interior.
- C. Fabric Wire (Steel): ASTM A392 Class 1 zinc coated steel wire.
- D. Barbed Wire: ASTM A121 Coating Type Z, galvanized steel; 12.5 gage thick wire, 2 strands, 4-point barbs of 14-ga wire at 3-inch oc.
1. Barbed wire supporting arms online posts shall be at an angle of approximately 45 degrees or vertical, as required, and shall be of sufficient strength to withstand a 250-lb load applied at the outer strand.
- E. Concrete: ASTM C94, Option A; Normal Portland Cement, 2,500 psi strength at 28 days.
- 2.02. COMPONENTS
- A. Dimensions for line posts shall conform to the following schedule:

Fabric Height	O.D.	Wall Thickness	Weight
6' and under	1.900"	0.140"	2.72 lb/ft
Over 6' to 8'	2.375"	0.154"	3.65 lb/ft
Over 8' to 12'	2.875"	0.203"	5.79 lb/ft

- B. Dimensions for terminal posts (end, corner, and pull) shall conform to the following schedule:

Fabric Height	O.D.	Wall Thickness	Weight
6' and under	2.375"	0.154"	3.65 lb/ft
Over 6' to 12'	2.875"	0.203"	5.79 lb/ft

- C. Dimensions for gate posts shall conform to the following schedule:

Gate Fabric Height up to and Including 6'	
Gate Leaf Width	Post O.D.
Up to 4'	3.500"
Over 4' to 10'	3.500"
Over 10' to 18'	4.000"
Gate Fabric Height Over 6' to 12'	
Gate Leaf Width	Post O.D.



Up to 6'	3.500"
Over 6' to 12'	4.000"
Over 12' to 18'	6.625"
Over 18' to 24'	8.625"

- D. Top and Brace Rail: 1.66-inch diameter, plain end, sleeve coupled.
  - E. Gate Frame: 1.900-inch diameter for welded fabrication.
  - F. Truss Rod: 0.375-inch diameter steel with a pressed steel tightener conforming to ASTM F626, capable of withstanding a tension of 2,000 lbs.
  - G. Fabric: 2-inch diamond mesh interwoven wire, 9 gage thick, top salvage twisted tight, bottom selvage twisted tight.
  - H. Tension Wire: 6 gage thick steel, single strand, marcelled, spiraled, or crimped, metallic-coated tension wire conforming to ASTM A824.
  - I. Tension Band: 0.105-inch-thick galvanized pressed steel complying with ASTM F626.
  - J. Minimum width of 0.75 inch.
  - K. Tension Bar: Provide one steel bar conforming to ASTM F626 for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
    - 1. Length not less than 2 inches shorter than full height of chain-link fabric
    - 2. Bars for 2" and 1¾" mesh shall have a minimum cross section of 3/16" x 3/4".
    - 3. Bars for 1" mesh shall have a cross section of 1/4" x 3/8".
    - 4. Bars for small mesh (3/8", 1/2", and 5/8") shall be attached (sandwiched) to the terminal post using a tension band.
  - L. Tie Wire: 0.148" inch thick galvanized steel wire conforming to ASTM F626.
- 2.03. ACCESSORIES
- A. Caps: Galvanized pressed steel conforming to ASTM F626; sized to post diameter, set screw retainer.
  - B. Fittings: Sleeves, bands, clips, rail ends, fasteners, and fittings; galvanized steel.
    - 1. General: Comply with ASTM F626
    - 2. Rail and Brace Ends: For each gate, corner, pull, and end post.
    - 3. Rail Fittings: Provide the following:
      - a. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
      - b. Rail Clamps: Line and corner boulevard clamps for connecting rails in the fence line-to-line posts.
  - C. Extension Arms: For each post unless otherwise indicated, provide galvanized pressed steel arms conforming to ASTM F626 with clips, slots, or other means for attaching strands of barbed wire, and means for attaching to posts. Post extensions shall be 12 inches to

accommodate 3 strands of barbed wire, capable of supporting a vertical 250-lb load, single arm, sloped to 45°.

1. Provide corner arms at fence corner posts unless extended posts are indicated.

D. Gate Hardware: Provide latches permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

1. Padlock and Chain: OWNER furnished.
2. Drive gates shall have a center plunger rod, catch, and semi-automatic outer catch.
3. Positive locking gate latch shall be fabricated of 5/16" thick x 1 3/4" pressed steel galvanized after fabrication.

## 2.04. GATES

### A. General:

1. Gate Types, Opening Widths, Fabric Heights, and Directions of Operation: As indicated on Drawings.
2. Factory assemble gates.
3. Design gates for operation by one person.
4. Match gate fabric to that of the fence system.

### B. Swing Gates:

1. Fabricate gates with minimum two hinges to permit 360-degree swing.
2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted. Welded joints shall be protected by applying zinc-rich paint in accordance with ASTM A780.

### C. Overhead Sliding Gates:

1. Framing and Posts: ASTM F1184, Class 2 for internal rollers.
  - a. Provide sch 40 gate posts in accordance with ASTM F1043.
2. Welded joints are to be protected by applying zinc-rich paint in accordance with ASTM A780.
3. Rollers for overhead and cantilever sliding gates: Bearing type. Furnish non-sealed bearings with grease fitting for periodic maintenance.
4. Secure rollers to post or frame without welding.
5. Manufacturer's standard overhead beam/structure, track, rollers, and accessories shall be designed to support the load of the gate panel taking into consideration wind load and possible icing. The support beam/structure to be galvanized or receive proper corrosion protection.
6. Provide galvanized steel drop bars with double gates.

### D. Cantilever Sliding Gates:

1. Gateposts:
  - a. Provide 4.000" O.D. sch 40 gate posts in accordance with ASTM F1043.

2. Fabricate gate leaf frames to meet the performance requirements of ASTM F1184, Type II, and specified performance requirements.
3. Vertical and horizontal members shall be spaced no greater than 8' apart.
4. Welded joints are to be protected by applying zinc-rich paint in accordance with ASTM A780.
5. Install fabric securely stretched and held in center of tubing.
6. Brace cantilever overhang frames with 3/8-inch brace rods. For gate leaf sizes greater than 23 feet, fabricate with additional lateral support rail welded adjacent to top and bottom horizontal rails.
7. Provide minimum overhang for each leaf opening size as follows:
  - a. Up to 10'-0": 6'-6"
  - b. 10'-0" to 14'-0": 7'-6"
  - c. 14'-1" to 22'-0": 10'-0"
  - d. 22'-1" to 30'-0": 12'-0"
8. Track: Combined, integral track and rail.
9. Rail: Aluminum extrusion; minimum total weight of 3.72 lb/ft; designed to withstand reaction load of 2,000 lbs.
10. Roller Track Assembly: Two swivel type, zinc, die cast trucks having four, sealed lubricant ball bearing wheels minimum 2 inches diameter by 9/16 inches width designed for same reaction load as rail. Provide two side-rolling wheels for each gate leaf to maintain alignment of truck in track.
11. Class 1-External Roller Design
  - a. Horizontal top and bottom steel pipe "track" members to be 2.375" O.D. in compliance with ASTM F1043 Group IA 1083 sch 40 pipe.
  - b. Vertical and internal members shall be 1.900" O.D. in compliance with ASTM F1043 Group IA 1083 sch 40 pipe.
12. Provide safety protective guards for the top and bottom external rollers.
13. Fasten trucks to post brackets by minimum 7/8-inch diameter, 1/2-inch shank ball bolts.
14. Provide galvanized steel guide wheel assemblies consisting of two rubber wheels of minimum 4-inch diameter with oil-impregnated bearings for each supporting post.
15. Attach guide wheel assembly to post so bottom horizontal member rolls between wheels and permitting adjustment to maintain plumb gate frames and proper alignment.
16. Gates shall be designed to open or close by applying an initial pull force no greater 40 lbs.
17. Galvanized steel drop bars shall be provided with double gates.
18. The length of back frame support section shall be a minimum of 40% of the opening.

#### 2.05. PRIVACY SLATS

A. Privacy Slats: HDPE strips, flat configuration, sized to fit fence fabric, UV inhibitors.

1. HDPE Properties

Melt Index	0.6
Density	0.957 g/cm <sup>3</sup>
Minimum Temperature	-76°F
Maximum Temperature	250°F
Tensile Strength	3,700 psi

2.06. FINISHES

- A. Components and Fabric: Galvanized to ASTM A123 for components; ASTM A153 for hardware; ASTM A392 for fabric; 1.2 oz/sq ft coating on fabric, posts, and extension arms.
- B. HDPE Components color: **Black**.
- C. Accessories: Same finish as fabric.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.
- B. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work. Do not begin installation and erection before final grading is completed, unless otherwise permitted.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02. INSTALLATION

- A. Install framework, fabric, accessories, and gates according to ASTM F567 and more stringent requirements if indicated.
- B. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, sprinkler systems, underground structures, benchmarks, and property monuments.
  - 1. Install fencing on established boundary lines inside property line.
- C. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials. Drill or hand excavate (using post hole diggers) holes for posts in firm, undisturbed or compacted soil.
- D. Place intermediate, terminal, and gate posts plumb, in holes as specified below.
  - 1. Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.

2. Check each post for vertical and top alignment and hold in position during placement and finishing operations.
  3. Unless otherwise indicated, extend top of footing 2 inches above finish grade. Slope top of concrete for water runoff.
  4. For concealed concrete footings, leave the top of the concrete foundation 2 inches below grade to allow covering with surface material.
- E. For posts set into concrete in sleeves, use steel pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
- F. For posts set into voids in existing concrete, form, or core drill holes not less than 5 inches deep and 3/4 inch larger than O.D. of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.
- G. Line Post Footing Depth Below Finish Grade:

Type of Post	Fabric Height	Hole Diameter at Top	Hole Depth	Post Embedment
Line	3' – 4'	6"	24"	21"
Line	5'	8"	30"	27"
Line	6' – 16'	9"	39"	36"

- H. Corner, Gate and Terminal Post Footing Depth Below Finish Grade:

Type of Post	Fabric Height	Hole Diameter at Top	Hole Depth	Post Embedment
Terminal	3' – 5'	10"	32"	30"
Terminal	6' – 16'	12"	38"	36"

- I. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete.
- J. Install top rail through line post caps, bending to radius for curved runs, and splice with 6-inch-long rail sleeves. Terminate at rail end attached to posts or post caps fabricated to receive rail at terminal posts.
- K. Install center and bottom brace rail on each gate, corner, pull, and end post. Install brace rails one bay in each direction from specified locations.

- L. Place fabric on outside of posts and rails.
  - M. Position bottom of fabric 2 inches above finished grade unless otherwise indicated.
  - N. Install horizontal tension wire along bottom of fence fabric within 6 inches of bottom of fabric and tie to each post.
  - O. Install tension wires through post cap loops before stretching fabric and tie to each post cap. Fasten fabric to tension wire using 11-ga galvanized steel hog rings spaced 24" O.C.
  - P. Do not stretch fabric until concrete foundation has cured 28 days.
  - Q. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
  - R. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers so that fabric remains in tension after pulling force is released.
    - 1. Use U-shaped tie wires, conforming to diameter of pipe to which attached, clasp pipe, and fabric firmly with ends twisted at least 2 full turns. Bend ends of wire to minimize hazard to persons or clothing.
  - S. Attach fabric to end, corner, and gate posts with tension bars spaced not more than 15 inches O.C. and tension band spaced 4" O.C.
    - 1. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
    - 2. Install nuts for tension bars and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
  - T. Install support arms sloped inward and attach barbed wire, tension and secure.
  - U. Support gates from gate posts. Do not attach hinged side of gate from building wall.
  - V. Install gate with fabric and barbed wire overhang to match fence. Provide gates with latch, catches, drop bolt.
    - 1. Lubricate hardware and other moving parts.
  - W. 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.
  - X. Provide concrete center drop to footing depth and drop rod retainers at center of double gate openings.
  - Y. Install posts with 6 inches maximum clear opening from end posts to buildings, fences and other structures.
- 3.03. PRIVACY SLATS
- A. Install slat inserts in vertical pattern woven through fence fabric.
  - B. Fasten slats according to manufacturer's instructions.
- 3.04. ERECTION TOLERANCES

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

- A. Maximum Variation from Plumb: 1/8 inch.
- B. Maximum Offset from Indicated Position: 1 inch.
- C. Minimum distance from property line: 6 inches.

END OF SECTION





## SECTION 329200 – TURF AND GRASSES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Lawn seeding.
  - 2. Lawn sodding.
  - 3. Meadow grasses and wildflowers.
- B. Related Requirements:
  - 1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
  - 2. Section 312000 "Earth Moving" for excavation, filling and backfilling, and rough grading.
  - 3. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.
  - 4. Section 334600 "Subdrainage" for below-grade drainage of landscaped areas.

#### 1.3 DEFINITIONS

- A. Final Completion: The proper installation of seed, sod, and meadow with final grades, mulch and irrigation functioning (if provided) with no indication of widespread plant death. For seeded and meadow areas, the seed must show germination with green shoots visible. It is possible to grant final completion to portions of the site without total project completion however all construction activities must be completed in the requested area.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- D. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- E. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.
- F. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

- G. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.
- H. Turf: A groundcover established from either lawn type seeds, lawn type sod or meadow seeds.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required maintenance periods.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf and meadow establishment.
  - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network, the NC Landscape Contractors Association, or the American Nursery and Landscape Association.
  - 2. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
  - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
    - a. Landscape Industry Certified Technician - Exterior.

- b. Landscape Industry Certified Lawncare Manager.
    - c. Landscape Industry Certified Lawncare Technician.
  - 5. Pesticide Applicator: State licensed, commercial.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Soil Analysis: For each un-amended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
  - 1. Test native in place surface soil and soil components of Planting Soils Type A.
  - 2. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
  - 3. Test shall include mechanical analysis of sand, silt and clay components.
  - 4. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Designer. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
  - 5. Soil tests shall include the following information:
    - a. Cation exchange capacity.
    - b. Percent of organic matter.
    - c. Stated recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    - d. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

## 1.9 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Final Completion.

B.

C. Grass Type	D. Fall Season	E. Spring Season
F. Cool season grasses	G. September 15-December 15	H. February 1 to May 15
I. Warm season grasses	J. Sept 1 to Oct 15	K. May 15-July 15
L. Grassy Meadows	M. Sept 1 to Oct 15	N. May 15-July 15

- O. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

## PART 2 - PRODUCTS

### 2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
  1. Quality: State-certified seed of grass species as listed below for solar exposure.
  2. Quality: Seed of grass species as listed below for solar exposure as directed by the Designer, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
  - 3.

C. Lawn Type	D. Seed Mix	E. Notes
F. Warm Season/ Seeded Lawn	G. Common Bermuda	H.
I. Cool Season	J. Turf Type Fescue	K.

L. Cool Season	M. Triple-Threat Turf Type Fescue	N.
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1.

## 2.2 TURFGRASS SOD

A. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Turfgrass Species: Provide the following as directed by the Designer:

C.

D. Lawn Type	E. Turfgrass Sod Species	F. Notes
G. Warm Season Lawn	H. Common Bermuda	I.
J. Warm Season Lawn	K. Tifway 419 Bermudagrass	L.
M. Warm Season Lawn	N. Tifgrand Bermudagrass	O.
P. Warm Season Lawn	Q. Patriot (OKC 18-4) Bermudagrass	R.
S. Warm Season Lawn	T. Zenith Zoysia	U.
V. Warm Season Lawn	W. Emerald Zoysia	X.
Y. Cool Season	Z. Turf Type Fescue	AA.
BB. Cool Season	CC. Triple-Threat Turf Type Fescue	DD.

## 2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Provide lime in form of ground dolomitic limestone or calcitic limestone depending on soil test.

## 2.4 ORGANIC SOIL AMENDMENTS

A. Soil Conditioner: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve;

soluble salt content of 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 70 percent of dry weight.
2. Sources: Agricultural, bark, bio-solids; municipal compost; or source-separated or compostable mixed solid waste.
  - a. Free of toxic materials to plant growth
  - b. Free of weed seeds.

## 2.5 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

## 2.6 PLANTING SOILS

- A. Planting Soil Type A: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
  1. Landscape contractor to rotary till the soil to a depth of 2-inches. Check the soil tillage depth and the fineness of the particles.
  2. Spread the fertilizer and lime as recommended in the lab results.
  3. Rotary till the soil to thoroughly mix the fertilizer and lime in the soil
  4. Broadcast the seed, straw, and spray the asphalt tack.
- B. Planting Soil Soil Type B: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land bogs, or marshes.
  1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of

- obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass; not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
2. Mix imported topsoil or manufactured topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil.
  3. Ratio of soil conditioner to Topsoil by Volume: 1:10.
  4. Weight of Slow-Release Fertilizer as per soil test.
  5. Weight of dolomitic limestone as per soil test.

## 2.7 SEED STABILIZATION

- A. Grass and meadow seed blankets and coverings:
  1. Lawn Areas: Free of plastic or other non biodegradable materials, seed free;
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) American Excelsior Company, Curlex NetFree.
      - 2) Granite Environmental, Coconut Blanket C4000BD.
      - 3) Tensar BioNet.

## 2.8 MULCHES

- A. General: Contractor to select the mulching products that best suit the grass seed selected. Choose from the following mulches:
  1. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
  2. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

## 2.9 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. To achieve Final Completion, provide the proper installation of seed, sod, and meadow with final grades, mulch and irrigation functioning (if required) with no indication of widespread plant death. For seeded and meadow areas, the seed must show germination with green shoots visible. Portions of the site may be granted Final Completion if all construction activities are be completed in that area.

#### 3.2 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Notify the Designer immediately and do not start landscape construction operations if:
  - 1. Grades or site features do not match the design.
  - 2. There is ponding or areas that do not appear to drain
  - 3. The subsoil contains no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 4. If the soils are frozen or moist beyond that required to produce optimal working conditions.
  - 5. Excessively dry soil that is not workable and which is too dusty.
  - 6. If the subsoil is over compacted.
  - 7. If irrigation main and lateral lines have not been installed.
  - 8. If irrigation main or lateral line trenches have not been compacted.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Designer and replace with new planting soil.
- E. Erosion Control Seeding Contamination: Evaluate the erosion control seeding used and confirm that potential seed sources will not interfere with the establishment of seeded lawns or meadows. Confer with the General Contractor on usage of erosion control seeding and potential threats to establishing lawns or meadows.



### 3.3 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
  - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
  - 2. Protect grade stakes set by others until directed to remove them.
  - 3. Protect areas that should not receive seed such as planting beds.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.4 TURF AREA PREPARATION

- A. Limit turf subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 4 inches.
  - 1. General
    - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    - b. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
    - c. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
    - d. Reduce elevation of planting soil to allow for soil thickness of sod.
    - e.
  - 2. Type A Soils: Apply amendments directly to final grade before loosening. Mix to a total depth of 4".
  - 3. Type B Soils: Spread planting soil to a depth of 4 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
  - 4. Thoroughly blend planting soil with organic amendments off-site before spreading
  - 5. Apply lime and fertilizers on surface, and thoroughly blend planting soil.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- D. Before planting, obtain Designer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

### 3.5 LAWN SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
  2. Do not use wet seed or seed that is moldy or otherwise damaged.
  3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at the rates specified by the seed provider.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:3 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate to form a continuous blanket 1 inch in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
1. Bond straw mulch by spraying with asphalt emulsion at a rate to resist wind erosion. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- F. Protect seeded areas from hot, dry weather or drying winds by applying hydromulch within 4 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

### 3.6 HYDROSEEDING

- A. Two Step Hydroseeding: Mix specified seed and fertilizer in water, using equipment specifically designed for hydroseed application.
- B. Apply seed and fertilizer at the recommended rates to bare soil.
- C. Apply hydromulch over seed mix. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. Mix slurry with nonasphaltic tackifier.
  2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight.

### 3.7 SODDING

- A. Lay sod within 24 hours of harvesting with tightly fitted joints. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
1. Lay sod across slopes exceeding 1:3.

2. Anchor sod on slopes exceeding 1:6 with wood pegs or in the bottom of swales with steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

### 3.8 STORM WATER MANAGEMENT PLANTING STABILIZATION

- A. Planting seed or meadow in storm water management areas:
  1. Prepare the soils according to plans and details including amendments.
  2. Micro grade to meet the requirements of the grading plan.
  3. Apply seed and hydromulch slurry to soil surface.
  4. Apply jute mat in continuous runs and attach with staples at 30" oc.
- B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- D. Mow, dethatch, core aerate, and rake existing turf.
- E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 4 inches.
  1. Confirm that there are no protected root zone areas that would require special procedures.
- H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.
- I. Apply seed or sod as shown on the plans and as required for new turf.
- J. Water newly planted areas and keep moist until new turf is established.

### 3.9 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
  1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
  2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:
1. Mow Bermuda Grass to a height of 1/2-inch to 1 inch.
  2. Mow Turf-Type Tall Fescue to a height of 2 inches to 3 inches.
- D. Turf Post-Fertilization: Apply commercial fertilizer or slow-release fertilizer after initial mowing and when grass is dry.
1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

### 3.10 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Designer:
1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 3 by 3 inches.
  2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
  3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
  4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.
- B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

### 3.11 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations.

Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

### 3.12 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.

### 3.13 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than the following periods:
  - 1. Maintenance Period: 12 months from date of Final Completion.
  - 2. Partial finally completed areas will require continued maintenance until the completion date set by the final phase of work.
- B. Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Meadow Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than maintenance period below.
  - 1. Maintenance Period: 12 months from date of Final Completion.
  - 2. Partial finally completed areas will require continued maintenance until the completion date set by the final phase of work.
- C. Maintenance Instructions: Submit recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year before expiration of required initial maintenance periods.
- D. Construction Maintenance Water: During the maintenance period water will be provided by the Contractor.

END OF SECTION 329200



## SECTION 329219 - SEEDING

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to perform seeding in accordance with the plans. All materials, testing, and procedures shall be of the type specified herein.

##### B. Section Includes:

1. Fertilizing.
2. Seeding.
3. Hydroseeding.
4. Mulching.
5. Maintenance.

#### 1.02. REFERENCES

##### A. ASTM International:

1. ASTM C602 - Standard Specification for Agricultural Liming Materials.
2. ASTM D977 - Standard Specification for Emulsified Asphalt.

#### 1.03. DEFINITIONS

- ##### A. Weeds:
- Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Wild Onion, Crotalaria, Witchweed, Perennial Sorrel, Sandbur, and Brome Grass.

#### 1.04. SUBMITTALS

##### A. Section 01 30 00 - Electronic Submittals.

##### B. Product Data:

Submit data, including source, for seed mix, fertilizer, mulch, and other accessories.

##### C. Samples of all materials shall be submitted for inspection and acceptance upon ENGINEER's request.

##### D. Manufacturer's Certificate:

Certify Products, including seed, limestone, and fertilizer, meet or exceed specified requirements.

1. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

##### E. Proposed Planting Schedule:

Indicate dates for all work during normal seasons. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

1.05. CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include maintenance instructions to be established by OWNER during a calendar year, including cutting method and maximum grass height and types, application frequency, and recommended coverage of fertilizer.

1.06. QUALITY ASSURANCE

- A. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.
- B. No material substitutions will be permitted without the prior written approval of the ENGINEER.
- C. Apply all materials in strict accordance with manufacturer's written instructions.

1.07. QUALIFICATIONS

- A. Seed Supplier: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section.

1.08. DELIVERY, STORAGE, AND HANDLING

- A. Section 01 55 00 - Site Access and Storage.
- B. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer. Fertilizer shall be cared for in such a manner that it will be protected against hardening, caking, or loss of plant food values. Any hardened or caked fertilizer shall be pulverized to its original conditions before being used.
- D. Damaged products shall be rejected upon delivery and promptly removed from the site.
- E. Products which must be stored prior to installation shall be protected from theft and damage by heat, moisture, rodents, or other causes.
- F. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways, and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.09. MAINTENANCE SERVICE

- A. Maintain all seeded areas in a condition approved by the ENGINEER until final acceptance of the Contract.
- B. Maintenance shall include, but not be limited to, repair of seeded areas, irrigation, and weed control. Protection shall be provided for all seeded areas against trespassing and damage.



Slopes shall be protected from damage due to erosion, settlement, and other causes and shall be repaired promptly.

## PART 2 PRODUCTS

### 2.01. SEED MIXTURE

- A. Grass seed shall be fresh, clean, dry, seed complying with the requirements of the North Carolina Seed Law and regulations adopted by the North Carolina Board of Agriculture.
- B. Seed shall have been approved by the North Carolina Department of Agriculture or any agency approved by the ENGINEER before being sown, and no seed will be accepted with a date of test more than nine (9) months prior to the date of sowing. Such testing, however, will not relieve the CONTRACTOR from responsibility for furnishing and sowing seed that meets these specifications at the time of sowing.
- C. Each variety of seed shall have a percentage of germination not less than 90, a percentage of purity not less than 85, and shall have not more than one percent weed content. When a low percentage of germination causes the quality of the seed to fall below the minimum pure live seed specified, the CONTRACTOR may elect, subject to the approval of the ENGINEER, to increase the rate of seeding sufficiently to obtain the minimum pure live seed contents specified, provided that such an increase in seeding does not cause the quantity of noxious weed seed per square yard to exceed the quantity that would be allowable at the regular rate of seed.

### 2.02. ACCESSORIES

- A. Mulching Material shall be one of the following:
  - 1. Oat, wheat, rye, or barley straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are acceptable.
  - 2. Biodegradable dyed-wood cellulose-fiber mulch, nontoxic, free of plant growth- or germination-inhibitors, with maximum moisture content of 15%, ash content 0.6 percent ( $\pm 0.2$  percent), water holding capacity of 1,050 grams water/100 grams dry fiber, and a pH range of 4.5 to 6.5.
- B. Fertilizer: Commercial grade; recommended for grass.
  - 1. The quality of fertilizer and all operations in connection with the furnishing of this material shall comply with the requirements of the North Carolina Fertilizer Law and regulations adopted by the North Carolina Board of Agriculture.
  - 2. For all areas to be seeded which are not classified as lawns, but would be classified as open fields, fertilizer shall be free-flowing, ready mixed 10-10-10 grade fertilizer. Upon written approval of the ENGINEER a different grade of fertilizer may be used, provided the rate of application is adjusted to provide the same amounts of plant food.
  - 3. For all areas to be seeded which are classified as lawns, fertilizer shall be as follows:
    - a. Fertilizer tablets: Agriform Planting Tablets 20-10-5 as manufactured by Scotts-Sierra Horticultural Products, or approved equal, may be used at installer's option.
    - b. Encapsulated fertilizer: Osmocote 19-6-12 as manufactured by Scotts-Miracle Gro, or approved equal, may be used at installer's option.

- C. Lime: ASTM C602, Class T agricultural limestone containing a minimum 80 percent calcium carbonate equivalent with a minimum 99 percent passing a No. 8 sieve and a minimum 75 percent passing a No. 60 sieve.
- D. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of grass.
- E. Erosion Fabric: Jute matting, open weave.
  - 1. Include manufacturer's recommended anchorage system for slope conditions.
- F. String: Inorganic fiber.
- G. Tackifier shall be one of the following:
  - 1. Asphalt Emulsion Tackifier
    - a. Asphalt emulsion, ASTM D977, Grade SS-1, nontoxic and free of plant growth- or germination-inhibitors.
  - 2. Non-asphaltic Tackifier
    - a. Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application, nontoxic, and free of plant growth or germination-inhibitors.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

- A. Verify that the areas of work have been properly contoured and brought to final grade prior to beginning work.
- B. Verify prepared soil base is ready to receive the Work of this section.
- C. Consult record drawings and installers to determine actual underground utility and drainage system locations in the vicinity of this work. Damage to known or unrecorded utilities will be repaired at the CONTRACTOR's expense.
- D. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  - 3. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.
- E. Notify the ENGINEER of any unforeseen conditions which will affect plant installation or growth.
- F. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by ENGINEER and replace with new planting soil.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02. SEEDBED PREPARATION

- A. Cut and satisfactorily dispose of weeds or other unacceptable growth on the areas to be seeded. Uneven and rough areas outside of the graded section, such as crop rows, farm contours, ditches and ditch spoil banks, fence line and hedgerow soil accumulations, and other minor irregularities which cannot be obliterated by normal seedbed preparation operations, shall be shaped, and smoothed as directed by the ENGINEER to provide for more effective seeding and for ease of subsequent mowing operations.
- B. Scarify or otherwise loosen the soil to a depth of not less than 6 inches except as otherwise provided below or otherwise directed by the ENGINEER. Break clods and work the top 2 to 3 inches of soil into an acceptable seedbed by the use of soil pulverizers, drags, or harrows; or by other methods approved by the ENGINEER. Remove all loose rock, roots, and other obstructions leaving surface reasonably smooth and uniform.
- C. On cut slopes that are steeper than 2:1, the depth of preparation may be reduced as permitted by the ENGINEER, but in all cases the slope surface shall be scarified, grooved, trenched, or punctured so as to provide pockets, ridges, or trenches in which the seeding materials can lodge.
- D. Do not prepare seedbeds when the soil is frozen, extremely wet, or when the ENGINEER determines that it is in an otherwise unfavorable working condition.
- E. Limestone may be applied at the rate described below as a part of the seedbed preparation, provided it is immediately worked into the soil. If not so applied, limestone and fertilizer shall be applied as described below.

### 3.03. FERTILIZING

- A. Equipment to be used for the application, covering, or compaction of limestone, fertilizer, and seed shall have been approved by the ENGINEER before being used on the project. Approval may be revoked at any time if equipment is not maintained in satisfactory working condition, or if the equipment operation damages the seed.
- B. Apply limestone, fertilizer, seed, and mulch within 24 hours after completion of seedbed preparation unless otherwise permitted by the ENGINEER. No limestone or fertilizer shall be distributed, and no seed shall be sown when the ENGINEER determines that weather and soil conditions are unfavorable for such operations.
- C. Apply lime at application rates indicated below. Work lime into top 6 inches of soil.
  - 1. The specified rate of limestone application may be reduced by the ENGINEER if pH tests indicate this to be desirable. It is the responsibility of the CONTRACTOR to obtain such tests and submit the results to the ENGINEER for adjustment in rates.
  - 2. Apply lime at a rate of 4,000 pounds per acre to all areas to be seeded which are not classified as lawns but would be classified as open fields.
  - 3. Apply lime at a rate of 92 pounds per 1,000 square feet or all areas to be seeded which are classified as lawns.
  - 4. When adverse seeding conditions are encountered due to steepness of slope, height of slope, or soil conditions, the ENGINEER may direct or permit those modifications be made in the above requirements which pertain to incorporating limestone into the

seedbed; covering limestone, seed, and fertilizer; and compacting the seedbed. Such modifications include but are not limited to the following:

- a. The incorporation of limestone into the seedbed may be omitted on:
  - 1) Cut slopes steeper than 2:1;
  - 2) On 2:1 cut slopes when a seedbed has been prepared during the excavation of the cut and is still in an acceptable condition; or
  - 3) On areas of slopes where the surface of the area is too rocky to permit the incorporation of the limestone.

D. Apply fertilizer at application rates indicated below. Mix fertilizer thoroughly into upper 2 inches of topsoil.

1. The specified rate of fertilizer application may be reduced by the ENGINEER if soil tests indicate this to be desirable. It is the responsibility of the CONTRACTOR to obtain such tests and submit the results to the ENGINEER for adjustment in rates.
2. Apply fertilizer at a rate of 1,000 pounds per acre to all areas to be seeded which are not classified as lawns but would be classified as open fields.
3. Apply fertilizer at a rate of 23 pounds per acre per 1,000 square feet to all areas to be seeded which are classified as lawns.

E. Lightly water soil to aid dissipation of fertilizer. Irrigate top level of soil uniformly.

F. When a combination seed and fertilizer drill is used, fertilizer may be drilled in with the seed after limestone has been applied and worked into the soil. If two kinds of seed are being used which require different depths of cover, the seed requiring the lighter cover may be sown broadcast or with a special attachment to the drill or drilled lightly following the initial drilling operation.

1. The rates of application of limestone, fertilizer, and seed on slopes 2:1 or steeper or on rocky surfaces may be reduced or eliminated.
2. Compaction after seeding may be reduced or eliminated on slopes 2:1 or steeper, on rocky surfaces, or on other areas where soil conditions would make compaction undesirable.

### 3.04. SEEDING

- A. All disturbed areas shall be seeded unless specifically indicated to receive other types of plantings or groundcovers.
- B. Temporary crops must be incorporated prior to seeding of permanent mixtures.
- C. Apply seed only on freshly prepared seedbed.
- D. Do not apply seed against the trunk or exposed root structure of existing trees.
- E. Do not seed areas in excess of that which can be mulched on same day.
- F. Do not sow immediately following rain, when ground is too dry, or when winds are over 5 mph.
- G. Planting Season:

1. The best seeding dates are between September 1 through September 30 and February 15 through March 20.
  2. Possible seeding dates are between September 1 through October 31 and February 15 through April 30.
  3. Between April 15 and August 15, add 10 lbs/acre German millet or 15 lbs/acre of Suangrass.
  4. Prior to May 1 or after August 15 add 25 lbs/acre rye (grain).
- H. Apply seed according to the following rates:

Temporary Non-Wetland Seeding Schedule		
Dates	Seeding Mixtures Species	Application Rate
Jan 1 – May 1	Rye Grain	120 lbs/acre
	Kobe Lespedeza	50 lbs/acre
May 1 – Aug 15	German Millet	40 lbs/acre
Aug 15 – Dec 30	Rye Grain	120 lbs/acre

Permanent Non-Wetland Seeding Schedule		
Dates	Seeding Mixtures Species	Application Rate
Sept 1 – Apr 1	Tall Fescue	120 lbs/acre
Apr 15 – June 30	Bermuda Grass	25 lbs/acre
Sept 1 – May 1	Sericea Lespedeza	15 lbs/acre
May 1 – Sept 1	Kobe Lespedeza	10 lbs/acre

Temporary Wetland Seeding Schedule		
Dates	Seeding Mixtures Species	Application Rate
Jan 1 – May 1	Rye Grain	120 lbs/acre
May 1 – Aug 15	German Millet	40 lbs/acre
Aug 15 – Dec 30	Rye Grain	120 lbs/acre

Permanent Wetland Seeding Schedule		
Dates	Seeding Mixtures Species	Application Rate
December 1 – April 1	Switchgrass-Carthage	3.5 lbs/acre
December 1 – April 15	Smartweed	2.0 lbs/acre
December 1 –May 1	Soft Rush	2.5 lbs/acre
December 1 –May 1	Fox Sedge	2.5 lbs/acre

- I. Immediately after application, harrow, drag, rake, or otherwise work seedbed so as to cover the seed with a layer of soil. The depth of covering shall be as directed by the ENGINEER. If two kinds of seed are to be used which require different depths of covering, they shall be sown separately.
- J. Lightly roll the surface and water with fine spray.
- K. Immediately following seeding and compacting, apply mulch to thickness of ½ to 1½ inches. Maintain clear of shrubs and trees. Unless directed otherwise, begin mulching at the top of the slopes and proceed downward.
  1. Mulch shall be uniformly spread by hand or by approved mechanical spreaders or blowers which will provide an acceptable application as described above.
  2. Before mulch is applied on cut or fill slopes which are 3:1 or flatter, and ditch slopes, remove and dispose of all exposed stones in excess of 3 inches in diameter and all roots or other debris which will prevent proper contact of the mulch with the soil.
  3. Exercise care to prevent displacement of soil or seed or other damage to the seeded area during the mulching operations.
  4. Take sufficient precautions to prevent mulch from entering drainage structures through displacement by wind, water, or other causes and shall promptly remove any blockage to drainage facilities which may occur.
  5. Anchor straw by one of the following methods:
    - a. Netting
      - 1) Securely anchor straw or hay mulch by using ENGINEER-approved netting anchored to the ground with pegs or staples to prevent it from floating as the vegetation grows. Instead of this anchorage, the CONTRACTOR may secure mulch by heavy biodegradable twine fastened by pegs or staples to form a grid with 6 to 10 feet spacing.
    - b. Tackifier
      - 1) Treat straw or hay with a tackifier at an application rate of 400 gal/acre unless otherwise approved by the ENGINEER. Blow from a machine, and uniformly deposit over designated areas in one operation. The CONTRACTOR may apply the tackifier as an overspray in a separate operation after placing the straw or hay.
      - 2) Cover/protect structures, poles, fences, and other appurtenances if mulch binder is applied in such a way that it may come in contact with or discolor those structures or appurtenances.
    - c. Crimping
      - 1) Immediately after spreading, anchor the mulch in the soil by using a mulch crimper consisting of a series of dull, flat discs with notched edges. Space the 20-inch diameter discs at about 8-inch centers. Equip the crimper with a ballast compartment to allow adjusting the weight for depth control.

- 2) Impress the mulch into the soil 1½ to 2½ inches deep in one pass of the crimper. This process may require more than one pass of the crimper to ensure adequate anchoring of the mulch.

- L. Apply water with fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

### 3.05. HYDROSEEDING

- A. When a hydraulic seeder is used for application of seed and fertilizer, the seed shall not remain in water containing fertilizer for more than 30 minutes prior to application unless otherwise permitted by the ENGINEER.
- B. Apply fertilizer, mulch and seeded slurry with hydraulic seeder evenly in one pass in accordance with the application rates described herein.
  1. Mix slurry with fiber-mulch tackifier in accordance with manufacturer's recommendations.
  2. Fiber mulch shall be mixed into the slurry such that the application rate of the fiber mulch is 1,500 to 2,000 pounds per acre.
- C. After application, apply water with fine spray immediately after each area has been hydroseeded. Saturate to 4 inches of soil and maintain moisture levels two to four inches.

### 3.06. SEED PROTECTION

- A. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- B. Provide wood or metal stakes 48 inches in height, set on eight (8) to 10-foot centers, connected by 2-inch minimum brightly colored flagging tape or fabric fencing to protect trees and vegetation to remain. Set perimeter of protection at the drip line of trees to remain unless approved otherwise by the ENGINEER.
- C. On slopes, protect against washouts by an approved method. Any washout that occurs shall be regraded and reseeded at the CONTRACTOR'S expense until good growth is established.
- D. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Overlap edges and ends of adjacent rolls minimum 12 inches. Backfill trench and rake smooth, level with adjacent soil.
- E. Secure outside edges and overlaps at 36-inch intervals with stakes.
- F. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- G. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.
- H. Remove nondegradable erosion-control measures after grass establishment period.

### 3.07. MAINTENANCE

- A. Cover crops or temporary crops must be mowed at proper time to prevent seed heads from maturing. Wheat may be harvested.

- B. Mow grass at regular intervals to maintain at maximum height of 2½ inches. Do not cut more than 1/3 of grass blade at each mowing. Perform first mowing when seedlings are 40 percent higher than desired height.
- C. Neatly trim edges and hand clip where necessary.
- D. Immediately remove clippings after mowing and trimming. Do not let clippings lay in clumps.
- E. Water to prevent grass and soil from drying out.
- F. Apply maintenance fertilizer in the amount of 500 pounds per acre following the initial establishment of groundcover. This application shall occur when vegetation is three (3) inches in height or 45 days after initial seeding, whichever comes first.
- G. Control growth of weeds. Apply herbicides. Remedy damage resulting from improper use of herbicides.
- H. Immediately reseed areas showing bare spots.
  - 1. If stand is less than 60% established, the entire area shall be reseeded according to specifications using the original lime, fertilizer and seeding rates.
- I. Repair washouts or gullies.
- J. Protect seeded areas with warning signs during maintenance period.
- K. Maintenance for Temporary Non-wetland seeding
  - 1. Winter, Early Spring, and Summer
    - a. Refertilize if growth is not fully adequate. Reseed, refertilize, and mulch immediately following erosion or other damage.
  - 2. Fall
    - a. Repair and refertilize damaged areas immediately. Top dress with 50 lbs/acre of nitrogen in March. If it is necessary to extend temporary cover beyond June 15 overseed with 50 lbs/acre Kobe Lespedeza in late February or early March.
  - 3. Temporary seeding must be followed up with permanent seeding as soon as practical.
- L. Maintenance for Temporary wetland seeding
  - 1. Winter, Early Spring, and Summer
    - a. Refertilize if growth is not fully adequate. Reseed, refertilize, and mulch immediately following erosion or other damage.
  - 2. Fall
    - a. Repair and refertilize damaged areas immediately. Top dress with 50 lbs/acre of nitrogen in March.
  - 3. Temporary seeding must be followed up with permanent seeding as soon as practical.

END OF SECTION 329219



## SECTION 329300 - PLANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

1. Plants.
2. Planting soils.
3. Tree stabilization.
4. Tree-watering devices.
5. Landscape edgings.

- B. Related Requirements:

1. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
2. Division 31 Section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
3. Division 31 Section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
4. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

#### 1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."
- B. Unit prices apply to authorized work covered by quantity allowances.
- C. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

#### 1.4 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than size not less than the diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- D. Finish Grade: Elevation of finished surface of planting soil.
- E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
- F. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- G. Planting Area: Areas to be planted.
- H. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.
- I. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- J. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- K. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- L. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- M. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.5 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site .

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
  - 2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
- B. Samples for Verification: For each of the following:
  - 1. Trees and Shrubs: Three Samples of each variety and size delivered to site for review. Maintain approved Samples on-site as a standard for comparison.
  - 2. Mulch: 1-quart volume of each type of mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
  - 3. Weed Control Barrier: 12 by 12 inches.
  - 4. Proprietary Root-Ball-Stabilization Device: One unit.
  - 5. Slow-Release, Tree-Watering Device: One unit of each size required.
  - 6. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
  - 7. Tree Grates, Frames, and Accessories: Manufacturer's standard size delivered to site for review, to verify design and color selected.
  - 8. Root Barrier: Width of panel by 12 inches.

- C. Soil Analysis: For each un-amended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Test native in place surface soil
  2. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
  3. Test shall include mechanical analysis of sand, silt and clay components.
  4. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Designer. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
  5. Soil tests shall include the following information:
    - a. Cation exchange capacity.
    - b. Percent of organic matter.
    - c. Stated recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
    - d. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.
- D. Requests for Substitution:
1. Substitutions for Convenience: Not accepted.
  2. Substitutions for Cause: Submit written request for substitution with reason for substitution and alternate suggestion.
    - a. Plant List: Investigate sources of supply prior to submitting bid. Confirm that size, variety and quantity of plants specified on Plant List can be supplied. Failure to take this precaution will not relieve the successful bidder from his responsibility for furnishing and installing all plants in strict accordance with the Contract requirements and without additional expense to the Owner.
    - b. Substitutions will not be permitted unless substantiated written proof is supplied that a specified plant is not obtainable. In this situation a proposal to use the nearest equivalent size or variety with an equitable adjustment of Contract Price will be considered.

## 1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
  - 1. Manufacturer's certified analysis of standard products.
  - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- D. Sample Warranty: For special warranty.

#### 1.9 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

#### 1.10 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
  - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
  - 2. Experience: Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
  - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  - 4. Personnel Certifications: Installer's field supervisor shall have certification in one or more of the following categories from the Professional Landcare Network:
    - a. Landscape Industry Certified Technician - Exterior.
    - b. Landscape Industry Certified Interior.
    - c. Landscape Industry Certified Horticultural Technician.
  - 5. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
  - 1. Selection of plants purchased under allowances is made by Designer, who tags plants at their place of growth before they are prepared for transplanting.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Selection:

1. Container Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
2. Select Plant Tagging: The Contractor will submit photos prior to nursery tagging to confirm the nursery has acceptable material for consideration.

E. Plant Material Observation: Designer may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Designer may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Designer of sources of planting materials seven days in advance of delivery to site.

## 1.11 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at Project site.

1. The following individuals must be present:
  - a. GC Contractor's site representative responsible for the Landscape Contractor's work
  - b. The Landscape Contractor's branch manager [or Owner] and job estimator.
  - c. The Project supervisor who will be directly responsible for field work and/or paperwork.

## 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- D. Handle planting stock by root ball.
- E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
  - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
- I. If plants are stored for over 24 hours provide the following:
  - 1. Set balled stock upright on ground and cover ball with soil, peat moss, sawdust, or other acceptable material to prevent wind, cold, or heat damage to the roots.
  - 2. Provide shade to shade requiring trees and shrubs.
  - 3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.13 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
  - 1. Notify Owner and Designer no fewer than two days in advance of proposed interruption of each service or utility.
  - 2. Do not proceed with interruption of services or utilities without Designer's written permission.
- C. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Final Completion.
  - 1. Spring Planting: March 15 – May 15.
  - 2. Fall Planting: September 15 – December 15.
- D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- E. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.
- F. Under no circumstances should work proceed prior to establishment of appropriate grades.
- G. The Contractor shall provide water for:
  - 1. The construction period till final acceptance
  - 2. Final acceptance through the maintenance period
- H. The Contractor shall supply watering labor as follows:
  - 1. The construction period till final acceptance
  - 2. Final acceptance through the maintenance period
- I. Unusual Field Conditions: It is the Contractor's responsibility to communicate to the Designer unusual field conditions found at the project site before and during construction. The presence of unusual field conditions such as wind, wetness, soil issues, invasive weeds, will require the Contractor take note and advise the Designer on how best to remedy the discovery.



1.14 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
  - b. Structural failures including plantings falling or blowing over.
  - c. Faulty performance of tree stabilization, edgings, and tree grates.
  - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Periods: From date of Final Acceptance.
  - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
  - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
  - c. Annuals: Three months.
3. Include the following:
  - a. Remove tree staking systems, above and below grade.
  - b. Remove tree saucers.
  - c. Expose root crowns of all trees planted on the job.
4. Include the following remedial actions as a minimum:
  - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
  - b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
  - c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
  - d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

## PART 2 - PRODUCTS

### 2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
  - 1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
  - 2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
  - 3. Provide trees from active, consistently aged specimens.
  - 4. Unless directly specified, provide only trees that are genetic clones of the requested variety.
- B. Select balled and burlapped material from nurseries who utilize root pruning practices and have a systematic approach to hardening off newly dug material.
- C. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Designer, with a proportionate increase in size of roots or balls.
- D. Provide small trees and shade trees that are grown on their own roots, not utilizing grafting or budding techniques (unless directed in the plant list).
- E. Provide container plant material that is free from circling roots or pot bound conditions.
- F. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- G. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- H. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

## 2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
  - 1. Provide lime in form of ground dolomitic limestone.

## 2.3 ORGANIC SOIL AMENDMENTS

- A. Soil Conditioner: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
  - 1. Pine bark soil conditioner: finely ground, well composted, pine bark mulch with a maximum particle size of 1/4 inch.
  - 2. Organic Matter Content: 70 percent of dry weight.
  - 3. Sources: Agricultural, bark, biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
    - a. Free of toxic materials to plant growth
    - b. Free of weed seeds.

## 2.4 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory. Several different blends may be necessary to meet the requirements.

## 2.5 PLANTING SOILS

- A. Planting Soil Type A: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
1. Screen to remove extraneous materials.
  2. Ratio of soil conditioner to Surface Soil by Volume: 1:5.
  3. Weight of Slow-Release Fertilizer per 1000 Sq. Ft. consult soil test.
  4. Weight of dolomitic limestone per soil test.
- B. Planting Soil Type B: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land bogs, or marshes.
1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and brome grass; not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
  2. Mix imported topsoil or manufactured topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil.
    - a. Ratio of soil conditioner to Topsoil by Volume: 1:10.
    - b. Weight of Slow-Release Fertilizer as per soil test.
    - c. Weight of dolomitic limestone as per soil test.

## 2.6 MULCHES

- A. Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a 1-inch sieve; soluble-salt content of 2 dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Type: Triple shredded hardwood.
  2. Color: Natural.

## 2.7 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
  - 1. Use pesticides on an as-needed basis.

## 2.8 HERBICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

## 2.9 PLANTING STABILIZATION MATERIALS

- A. Seed blankets and coverings:
  - 1. Products for Steep Slopes (Greater than 3:1): Made from biodegradable jute matting, free of plastic or other non-biodegradable materials, seed free.
  - 2. Staples: Galvanized staples 6" in length.

## 2.10 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
  - 1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
  - 2. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
  - 3. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
  - 4. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

## 2.11 LANDSCAPE EDGINGS

- A. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
  - 1. Edging Size: As approved by the Designer.
  - 2. Stakes: Tapered steel, a minimum of 12 inches long.
  - 3. Accessories: Standard tapered ends, corners, and splicers.
  - 4. Finish: Manufacturer's standard paint.
    - a. Paint Color: As selected by the Designer.

## 2.12 MISCELLANEOUS PRODUCTS

- A. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.
- B. Planter Filter Fabric: Nonwoven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. To achieve Final Completion, provide proper installation of plant material with final grades, mulch and irrigation (if provided) functioning with no indication of widespread plant death. Portions of the site may be granted Final Completion if all construction activities are completed in that area.

### 3.2 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
  - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  - 2. Conduct water percolation tests to verify that planting depths and drainage will meet the needs of the plants that have been selected. Inform the Designer of any drainage issues.
  - 3. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
  - 4. Along roadways and in landscape islands, remove gravel and asphalt from landscape beds.
  - 5. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

6. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  7. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Designer and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Designer's acceptance of layout before excavating or planting. Make minor adjustments as required.

### 3.4 GENERAL REQUIREMENTS FOR ALL PLANTING TYPES

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Obstructions: Notify Designer if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- D. Before planting, obtain Designer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- E. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
1. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

2. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
  3. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  4. Maintain supervision of excavations during working hours.
  5. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
  6. If subdrainage is shown on Drawings or required under planting areas, insure contact between the root ball and subdrain pipe.
- F. After excavation examine the area for potential drainage difficulties matched to plant varieties and inform the Designer of potential poorly drained areas. Notify Designer if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits. Discuss variations in the depth of planting with the Designer prior to planting.
- G. Fill excavations with water and allow it to percolate away before positioning trees and shrubs.
- H. Set out and space plants according to the planting plans and notes in even rows with triangular spacing unless otherwise indicated.
- I. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.
- J. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- K. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- L. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- M. Backfill plants with the materials and methods indicated in the Tables below and with the following instructions:
1. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  2. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  3. Continue backfilling process. Water again after placing and tamping final layer of soil.
- N. **SOIL COMPACTION – GENERAL REQUIREMENTS**
1. Acceptable Compaction: Good rooting anticipated, but increasing settlement expected as compaction is reduced and/or in soil with a high organic matter content.



2. Standard Proctor Method – 75-85%; soil below 75% is unstable and will settle excessively.

### 3.5 MASS PLANTING AREA REQUIREMENTS

- A. Preparation - Loosen area of planting areas to a minimum depth indicated in the table below. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

PLANTING TYPE	TREATMENT AREA	SOIL TREATMENT	BACKFILL FOR EXCAVATION
Shrub and Groundcover Masses	Entire planting area	Loosen 8" deep	Use Planting Soil Type A or Type B
Mass Perennials	Entire planting area	Loosen 8" deep	Use Planting Soil Type A or Type B
Mass Annuals	Entire planting area	Loosen 8" deep	Use Planting Soil Type A or Type B

1. Apply slow release fertilizer and amendments directly to grade before loosening.
2. Thoroughly mix amendments and soil to the depths indicated in Table 1 to produce a uniform, loose, friable planting bed.
3. Soil generated from excavations may be used after properly amended as specified.

### 3.6 STORM WATER MANAGEMENT PLANTING STABILIZATION

- A. Planting plugs and small container plants in storm water management areas:
  1. Prepare the soils according to plans and details including amendments.
  2. Micro grade to meet the requirements of the grading plan.
  3. Apply jute mat in continuous runs and attach with staples at 30" oc.
  4. Cut a small slit in the jute matt and install plugs into soil.
  5. If deer or water fowl pose a potential threat, use a single staple for each plant across the root ball to prevent the roots from being dislodged.

### 3.7 SOLITARY TREES AND SHRUBS PLANTING REQUIREMENTS

- A. Preparation - Loosen area of planting areas to a minimum depth indicated in the table below. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

	Treatment area	Soil treatment	Backfill from excavation
Solitary Trees	10' wider than the root ball	Loosen 12" deep	Use Planting Soil Type A or Type B
Solitary Shrubs	10' wider than the root ball	Loosen 12" deep	Use Planting Soil Type A or Type B

1. Soil generated from excavations may be used after properly amended as specified.

### 3.8 MECHANIZED TREE-SPADE PLANTING

- A. Supply trees as indicated in the plant list as harvested local trees.
- B. The Designer shall tag all trees to be locally harvested with tree spade techniques.
- C. Trees shall be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
- D. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- E. Cut exposed roots cleanly during transplanting operations.
- F. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.
- G. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
- H. Cut exposed roots cleanly during transplanting operations.

- I. Plant trees as shown on Drawings, with the following procedures :
  1. Lower trees without damaging trunk or major branches
  2. Fit the root ball into the hole leaving a minimum of gap between the root ball and hole.
  3. Fill the remaining gap with a 70% sandy loam topsoil, 30% organic matter and fertilizer blend. Use water to carry mixture to the bottom of the excavation to insure the gap is full. Allow to drain and return the next day and repeat as necessary until all gaps are filled.
  4. Stake the tree with appropriate cabling systems and insure the tree is plumb.
  5. Mulch the tree planting area.
- J. Where possible, orient the tree in the same direction as in its original location.
- K. Supply one slow release watering bag per 4.5” caliper of tree.

### 3.9 PLANT STABILIZATION

- A. Install plant stabilization as follows unless otherwise indicated:

PLANT SIZE	STABILIZATION METHOD
3” to 6” in Caliper	Anchor 3 guys to 30” wood stakes. Install guy wires allowing enough slack to avoid rigid restraint of tree. Provide soft flexible protection of the trunk from the guy wires. Attach flags to each guy wire, 30 inches above finish grade.
Less than 12’ tall	Provide two 6’ tall hardwood stakes driven into the ground at the edge of the root ball 2’ deep. Fasten the tree to the stakes with flexible bands capable of holding the plant steady but not binding.

### 3.10 PLANT PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.

### 3.11 PLANTING AREA MULCHING

- A. Layout mulch beds carefully with smooth lines and as indicated on the drawings. Mulch backfilled surfaces of planting areas and other areas indicated.
- B. Organic Mulch in Planting Areas: Apply over whole surface of mass planting areas or on isolated plantings as follows:
  1. 3” minimum depth for trees, shrubs and groundcovers
  2. 1 ½” minimum depth for groundcovers, perennials, and annual beds.
- C. Do not place mulch within 3 inches of tree or large shrub trunks.

3.12 EDGING INSTALLATION

- A. Chiseled Edging: Construct chiseled edge separating mulch areas from lawn as shown in the drawings.
- B. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

3.13 TREE GRATE INSTALLATION

- A. Tree Grates: Install according to manufacturer's written instructions. Set grate segments flush with adjoining surfaces. Shim from supporting substrate with soil-resistant plastic. Maintain a 3-inch- minimum growth radius around base of tree; break away portions of casting, if necessary, according to manufacturer's written instructions.

3.14 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.15 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

### 3.16 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Designer.
  - 1. Submit details of proposed pruning and repairs.
  - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
  - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Designer.
- B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Designer determines are incapable of restoring to normal growth pattern.
  - 1. Provide new trees of same size as those being replaced.
  - 2. Species of Replacement Trees: Same species being replaced.

### 3.17 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before Final Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

### 3.18 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
  - 1. Maintenance Period: 12 months from date of Final Completion.

- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
  - 1. Maintenance Period: 12 months from date of Final Completion.
- C. For Mechanized Tree Spade Trees: Provide 3 months of watering by refilling slow release water bags from the date of installation.

END OF SECTION 329300

SECTION 330110.58 - DISINFECTION OF WATER UTILITY PIPING SYSTEMS

- 1.1 Refer to Appendix A, Section 3.0 - Design Considerations for Water System Extensions and Section 10.0 - Material Specifications for Water System Extensions (Town of Beaufort Standard Specifications).

END OF SECTION 330110.58





## SECTION 330112 - IDENTIFICATION FOR UTILITIES PIPING

### PART 1 GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Underground Pipeline Detection and Warning.
  - a. Tracer wire system
    - 1) Vinyl/PVC adhesive tape.
    - 2) Polyethylene adhesive tape.
    - 3) Direct bury wire splice kits.
  - b. Tracer wire system testing
  - c. Metal detectable underground warning tape.
  - d. Marker posts.
2. Above Ground Piping and Valve Identification at CFPUA Facility Sites.
  - a. Tags
  - b. Applied pipe markers.

B. Related Requirements:

1. Section 09 91 00 - Painting and Coating: Execution requirements for painting specified by this Section.
2. Section 33 05 07.13 - Horizontal Directional Drilling: Materials and methods for piping and appurtenances.
3. Section 33 05 07.23 - Jacking and Boring: Materials and methods for carrier pipes and appurtenances.
4. Section 33 14 13 - Water Distribution Piping and Appurtenances: Materials and methods for piping and appurtenances.
5. Section 33 14 14 - Public Water Service Connections: Materials and methods for piping, valves, and appurtenances.
6. Section 33 14 19 - Water Distribution Valves, Fire Hydrants, and Backflow Prevention: Materials and methods for valves, and appurtenances.
7. Section 33 31 23 - Sanitary Sewer Force Mains, Valves and Appurtenances: Materials and methods for piping, valves, and appurtenances.
8. Section 40 71 00 - Magnetic Flow Meter
9. Section 43 21 39.13 - Submersible End Suction Pumps: Materials and methods for piping, valves, pumps, and other station equipment.

#### 1.2 REFERENCE STANDARDS

- A. NCGS 87-8A Underground Utility and Damage Prevention Act
- B. American Public Works Association: Uniform Color Code
- C. American Society of Mechanical Engineers: ASME A13.1 - Scheme for the Identification of Piping Systems.

#### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog literature for each product required.

## PART 2 PRODUCTS

### 2.1 UNDERGROUND PIPELINE DETECTION AND WARNING

1. Tracer Wire
  - a. Vinyl/PVC adhesive tape.
  - b. Polyethylene adhesive tape.
2. Direct bury wire splice kits.
3. Metal detectable underground warning tape.
4. Refer to CFPUA Material Specification Manual (MSM) for the following products:

MSM Section	Material
K-Miscellaneous	Warning Tape
L-Electrical	Wire and splice kits

### 2.2 ABOVE GROUND PIPING AND VALVE IDENTIFICATION

- A. Above Grade Pipe Identification
1. Color-Coding and Lettering Size: Conform to ASME A13.1.
  2. Applied Pipe Markers
    - a. Factory-fabricated, flexible, semi-rigid plastic.
    - b. Preformed to fit around pipe or pipe covering.
    - c. Larger sizes may have maximum sheet size with spring fastener.
  3. Applied Tape Pipe Markers
    - a. Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
  4. Stencils
    - a. Clean-cut symbols.
    - b. Letters:
      - 1) Up to 2-inch Outside Diameter of Insulation or Pipe === ½-inch high letters.
      - 2) 2-½- to 6-inch Outside Diameter of Insulation or Pipe == 1-inch high letters.
      - 3) Over 6-inch Outside Diameter of Insulation or Pipe == 1-¾-inch high letters.
      - 4) Stencil Paint: As specified in Section 099000 - Painting and Coating; semi-gloss enamel.
- B. Valves
1. Plastic Tags
    - a. Laminated three-layer plastic with engraved letters on light, contrasting background color.
    - b. Minimum Tag Size and Configuration: 1-½ inch.
  2. Metal Tags

- a. Stainless-steel construction; stamped letters.
- b. Minimum Tag Size and Configuration: 1-½ inch with finished edges.

### PART 3 EXECUTION

#### 3.1 PREPARATION

- A. Identify prescribed materials and color code for each pipeline type to be installed.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Prepare surfaces as specified in Section 09 90 00 - Painting and Coating for stencil painting.

#### 3.2 INSTALLATION

- A. Buried Pipeline Detection and Warning
  - 1. Tracer wire system termination and access.
    - a. Tracer wire systems must be installed as a single continuous wire. No looping or coiling of wire is allowed.
    - b. All tracer wire termination points must be grade level/in-ground access boxes identified with “sewer” or “water” cast into the cap.
    - c. A minimum of 2 ft. of excess/slack wire is required in all tracer wire access boxes after meeting final elevation.
    - d. Runs without service laterals or hydrants shall provide intermediate tracer wire access at minimum 1,000-foot intervals and must be provided utilizing a grade level/in-ground access box located at the edge of the road right-of-way and outside the roadway surface.
    - e. Termination and access shall be installed as indicated on the Drawings for all pressure piping at the following locations:
      - 1) Cast iron boxes located at minimum 1,000-foot intervals
      - 2) All in-line valve boxes on water mains and services and on sewer force mains and services.
      - 3) At hydrant valve boxes and hydrants
      - 4) Water meter service boxes
  - 2. Tracer wire system grounding
    - a. Tracer wire must be properly grounded at all dead ends/stubs and at minimum 1,000-foot intervals.
    - b. Grounding shall be achieved by use of a drive-in magnesium grounding anode rod, manufactured for this purpose, with a minimum of 3-feet of tracer connected to anode and buried at the same elevation as the utility
    - c. When grounding the tracer wire at dead ends/stubs, the grounding anode shall be installed in a direction 180-degrees opposite of the tracer wire, at the maximum possible distance.
  - 3. Tracer wire repairs
    - a. Any damage occurring during installation of the tracer wire must be immedi-

ately repaired by removing the damaged wire, and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

4. Tracer wire attachment and connections
  - a. Tracer wire shall be installed at the bottom half (8-9 o'clock or 3-4 o'clock position) of the pipe and secured (taped/tied) at 5-foot intervals.
  - b. Mainline tracer wire shall not be connected to existing conductive pipes. Treat as a mainline dead end and ground using an anode buried at the same depth as the tracer wire.
  - c. All service lateral tracer wires shall be a single wire, connected to the mainline tracer wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline tracer wire.
  - d. In occurrences where an existing tracer wire is encountered on an existing utility that is being extended or tied into, the new tracer wire and existing tracer wire shall be connected using approved splice connectors, and shall be properly grounded at the splice location as specified.
  - e. A mainline tracer wire must be installed, with all service lateral tracer wires properly connected to the mainline tracer wire, to ensure full tracing/locating capabilities from a single connection point.
  - f. Lay mainline tracer wire continuously, by-passing around the outside of manholes/structures, valves, fittings on the North or East side.
  - g. Tracer wire on all service laterals must terminate at an approved tracer wire access located directly above the service lateral at the edge of road right of way.
  - h. Connect tracer wire using direct bury splice kits in accordance with manufacturer's recommendations
5. Tracer wire testing and verification
  - a. Provide locating equipment to verify tracer wire locating system in presence of CFPUA or ENGINEER construction observer.
  - b. The test will take the following form:
    - 1) A standard 5-watt generator will be used to provide an AC current on the wire.
    - 2) The frequency of the signal from the generator will be initially restricted to 33 kHz or less.
    - 3) A standard hand-held detector will be used to trace the signal.
  - c. The installed tracer wire will be deemed to pass the test if using the above set up:
    - 1) The tracer wire is accessible at all access points.
    - 2) The tracer wire can be traced from access point to access point.
    - 3) Widely-spaced access points can be traced out in the worst-case from each end to a common meeting point between them.
    - 4) Depth readings are consistent and accurate to within a 15:1 depth to diameter ratio.
6. Horizontal Directional Drill and Bore/Jack Crossings
  - a. Follow special tracer wire procedures identified in those specification sections.

**B. Buried Pipeline Metal Detectable Warning Tape**

- a. For all diameter potable water mains (excluding 1-inch service lines) and all diameter sewerage force mains
    - 1) Install 1'-6" deep and directly above pipeline during backfilling operation.
- C. Above Ground Piping and Valve Identification at CFPUA Facility Sites:
  - 1. Piping:
    - a. Identify with plastic tape pipe markers or stenciled painting.
    - b. Apply stencil painting as specified in Section 09 90 00 - Painting and Coating.
    - c. Identify service, flow direction, and pressure.
    - d. Install in clear view and align with axis of piping.
    - e. Locate identification not to exceed 20 feet on straight runs, including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
  - 2. Valves:
    - a. Install tags using corrosion-resistant chain.
    - b. Number tags consecutively by type and location.

#### PART 4 MEASUREMENT AND PAYMENT

See Section 01 22 00.

END OF SECTION 330112



SECTION 330505.31 - HYDROSTATIC TESTING

- 1.1 Refer to Appendix A, Section 3.0 - Design Considerations for Water System Extensions and Section 10.0 - Material Specifications for Water System Extensions (Town of Beaufort Standard Specifications).

END OF SECTION 330505.31





## SECTION 330505.36 - VACUUM TESTING

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to vacuum test manholes after installation in accordance with the plans. All testing procedures and equipment shall be as specified herein.

##### B. Section Includes: Vacuum testing of manholes.

#### 1.02. REFERENCE STANDARDS

##### A. ASTM International:

1. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.

#### 1.03. DIRECTIVES TO THE CONTRACTOR

##### A. CONTRACTOR shall be familiar with and/or provide upon request the following:

1. Testing procedures.
2. List of test equipment.
3. Testing sequence schedule.
4. Provisions for disposal of flushing and test water.
5. Certification of test gage calibration.
6. Test and Evaluation Reports: Indicate results of manhole tests.

#### 1.04. QUALITY ASSURANCE

##### A. Perform Work according to ASTM standards.

### PART 2 PRODUCTS

#### 2.01. VACUUM TESTING

##### A. Equipment:

1. Vacuum pump.
2. Vacuum line.
3. Vacuum Tester Base:
  - a. Compression band seal.
  - b. Outlet port.
4. Shutoff valve.
5. Stopwatch.
6. Plugs.

7. Vacuum Gage: Calibrated to 0.1 in. mercury.

B. Manufacturers:

1. Manhole vacuum testing equipment shall be manufactured by Cherne Industries of Shakopee, Minnesota or approved equal.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that manholes are ready for testing.

1. Manholes shall be constructed to provide a true circular inside diameter with properly corbeled tops, satisfactory inverts and properly placed steps and castings. Any visible leaks in the manholes shall be completely stopped to the satisfaction of the ENGINEER.
2. Vacuum test the assembled manhole after completing pipe connections, sealing, and allowing mortar or cement proper curing time.

B. Verify that manholes are backfilled.

C. The vacuum test requirement will not apply to any existing manhole, or any existing manhole that has been converted to a drop manhole by the contract.

D. Vacuum testing is not required on manholes with pipe connections in excess of 30 inches in diameter.

3.02. FIELD QUALITY CONTROL

A. Manhole Testing:

1. All sanitary sewer manholes constructed by the CONTRACTOR shall be vacuum tested for leakage in the presence of the ENGINEER.
2. Test manholes with manhole frame set in place.
3. Vacuum Testing:
  - a. Comply with ASTM C1244.
  - b. Plug pipe openings with suitably sized and rated pneumatic or mechanical pipeline plugs. Place plugs a minimum of 6 inches beyond the manhole wall and brace to prevent displacement of the plugs or pipes during testing.
  - c. All lifting holes shall be plugged with an approved non-shrink grout inside and out.
  - d. The test head shall be placed at the inside of the top of the cone section of the manhole and the seal inflated in accordance with the manufacturer's recommendations.
  - e. Position the vacuum tester head assembly according to the manufacturer's recommendations. Draw a vacuum of 10 inches of mercury, close the valve on the vacuum line and shut off the vacuum pump and measure the time for the vacuum to drop to 9 inches of mercury. The manhole shall pass when the time to drop to 9 inches of mercury meets or exceeds the table below:

Manhole Depth	Manhole Diameter		
	4-feet	5-feet	6-feet
	Time (seconds)		
$\leq 10$ -feet	60	75	90
$>10$ -feet and $\leq 15$ -feet	75	90	105
$> 15$ -feet	90	105	120

- f. Record vacuum drop during test period.
  - g. If vacuum drop is greater than 1 in. mercury during testing period, remove the head assembly and coat the manhole interior with a soap and water solution and repeat the vacuum test for approximately 30 seconds. Leaking areas will have soapy bubbles. Make the necessary repairs and repeat the test until the manhole passes.
  - h. If vacuum drop of 1 in. mercury does not occur during test period, manhole is acceptable; discontinue testing.
4. Repair visible leaks regardless of quantity of leakage.

END OF SECTION 330505.36



## SECTION 330505.41 - AIR TESTING

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to perform and complete air testing. All materials and procedures shall be of the type specified herein.

##### B. Section Includes: Low-pressure air testing of gravity sewer piping.

#### 1.02. SUBMITTALS

##### A. Section 01 30 00 - Electronic Submittals.

##### B. Submit following items prior to start of testing:

1. Testing procedures.
2. List of test equipment.
3. Testing sequence schedule.
4. Provisions for disposal of flushing and test water.
5. Certification of test gage calibration.

##### C. Test and Evaluation Reports: Indicate results of piping tests.

#### 1.03. QUALITY ASSURANCE

##### A. Perform Work according to 15A NCAC 02T and AWWA standards.

### PART 2 PRODUCTS

#### 2.01. AIR TESTING

##### A. The CONTRACTOR shall furnish all equipment necessary to conduct the air tests including, but not limited to:

##### 1. Air compressor.

- a. Compressor capacity shall be sufficient to pressurize the sewer main to 4 PSIG within a time equal to or less than the required test time. The following equation may be used to ensure compliance with this requirement:

$$C = \frac{0.17 \times D^2 \times L}{T}$$

C=Required Compressor Capacity (cfm)

T=Required Test Time (min)

D=Pipe Internal Diameter (feet)

L=Length of Test Section (feet)

Q=Allowable Air Loss Rate (cfm)

b. The following allowable air loss rates will be used for all pipe tests:

Pipe Size	4"	6"	8"	10"	12"	15"	18"	21"	24"
Q (cfm)	2	2	2	2.5	3	4	5	5.5	6

2. Air supply line.
3. Shutoff valves.
4. Pressure regulator.
5. Pressure relief valve.
6. Stopwatch.
7. Plugs.
8. Pressure Gage: Calibrated to 0.1 psi.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

- A. All materials used must have a preliminary inspection by the ENGINEER, or his representative, before materials are used for testing purposes. Rejection of material not meeting these specifications will be ordered and such materials shall not be used in the testing process.
- B. Verify that piping is ready for testing.
- C. Verify that trenches are backfilled.
- D. Air tests will not be required on pipe with diameters exceeding 30 inches. Acceptance of pipes exceeding 30 inches will be based on infiltration tests, exfiltration tests, and/or visual inspection of the joints.

#### 3.02. PREPARATION

- A. Lamping:
  1. Lamp gravity piping after flushing and cleaning.
  2. Perform lamping operation by shining light at one end of each pipe section between manholes.
  3. Observe light at the other end. Accepted sanitary sewer lines shall be free and clean from obstructions and exhibit a fully circular pattern.
  4. Pipe not installed with uniform line and grade will be rejected.
  5. Remove and reinstall rejected pipe sections.
  6. Clean and lamp until pipe section is installed to uniform line and grade.
- B. Plugs:

1. Plug outlets, wye branches, and laterals.
2. Brace plugs to resist test pressures.
3. Plugs in sewers 18 inches in size and larger shall be connected by steel cable for thrust reaction.

### 3.03. FIELD QUALITY CONTROL

#### A. Low-Pressure Air Testing:

1. PVC and DIP gravity sewer mains shall be tested for exfiltration by air test in accordance with ASTM F1417 "Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air". Concrete pipe 30 inches in diameter and smaller shall be tested in accordance with ASTM C924. Exfiltration tests shall be performed on every reach of sanitary sewer line between manholes. The sewer section shall be plugged at both ends.
2. The line will be pressurized with a single hose and monitored by a separate hose connection from the plug. Air then shall be slowly introduced into the sealed line until the internal air pressure reaches 4.0 psig
3. If groundwater is present at the sewer, the height of the groundwater above the top of the pipe shall be determined by measuring the water level in air excavation beside each manhole in the reach to be tested, or in another manner agreeable to the OWNER.
4. For every foot of ground water above spring line of piping, increase starting air test pressure by 0.43 psi.
5. Do not increase pressure above 9 psig.
6. Allow pressure to stabilize for at least two minutes.
7. Adjust pressure to 3.5 psig or to increased test pressure as determined above when ground water is present. The time required for the pressure to drop 1.0 psi will be observed and recorded at this time
8. The following equation shall be used to determine the minimum time allowed for a pressure drop of 1.0 psig:

$$T = \frac{0.085 \times D \times K}{Q}$$

T = shortest time allowed for the air pressure to drop 1.0 psig (s)

K =  $0.000419 \times D \times L$ , but not less than 1.0

Q = leak rate in cfm/ft<sup>2</sup> of internal surface = 0.0015 cfm/ft<sup>2</sup>

D = measured average inside diameter of sewer pipe (in)

L = length of test section (ft)

- a. The following table is based on the preceding equation and should be used as a guide only.

Pipe Diameter (inches)	Specification Time for Length Shown (Minutes : Seconds)							
	100ft	150ft	200ft	250ft	300ft	350ft	400ft	450ft
<b>4</b>	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
<b>6</b>	5:40	5:40	5:40	5:40	5:40	5:40	5:41	6:24
<b>8</b>	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
<b>10</b>	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
<b>12</b>	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
<b>15</b>	14:10	14:10	17:48	22:15	26:42	31:09	35:35	40:04
<b>18</b>	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
<b>21</b>	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
<b>24</b>	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33

9. For testing a sewer system with one or more installed service lateral pipes, an effective pipe length shall be added to the total sewer main pipe length. The equation used to calculate Effective Pipe Length is as follows:

$$L_e = \frac{d^2 \times l}{D^2}$$

$L_e$ =Effective Pipe Length (added to Total Test Length)

$d$ =Diameter of Service Lateral Pipe

$l$ =Length of Sewer Lateral

$D$ =Diameter of Sewer Main Pipe being tested

10. If the time for the air pressure to decrease from 3.5 PSIG to 2.5 PSIG is equal to or greater than that shown in the previous equation or table, the pipe shall be presumed to be free from defect.
11. When these times are not attained, the pipeline has failed the test. The CONTRACTOR shall, at his own expense, determine the source(s) of leakage, and repair or replace all defective materials or workmanship.
12. Repair visible leaks regardless of quantity of leakage.
13. After repairs have been made, the sewer sections shall be retested. This process shall be repeated until all sewer sections pass the air tests.

END OF SECTION



## SECTION 330505.43 - MANDREL TESTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Scope of Work:
  - 1. Furnish all labor, equipment, materials, and incidentals necessary to perform and complete mandrel testing. All materials and procedures shall be of the type specified herein.
- B. Section Includes: Deflection testing of plastic sewer piping.

#### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
  - 2. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

#### 1.3 SUBMITTALS

- A. Section 013300 - Submittal Procedures
- B. Submit following items prior to start of testing:
  - 1. Testing procedures.
  - 2. List of test equipment.
  - 3. Testing sequence schedule.
  - 4. Provisions for disposal of flushing and test water.
  - 5. Certification of test gage calibration.
  - 6. Deflection mandrel drawings and calculations.
- C. Test and Evaluation Reports: Indicate results of piping tests.

### PART 2 - PRODUCTS

#### 2.1 DEFLECTION TESTING

- A. Equipment:

1. "Go, no go" mandrel.
  - a. Cylindrical in shape having 9 possible contact points with the pipe. Mandrels with fewer will be rejected as inaccurate. Submit a certified drawing of the mandrel to the ENGINEER for approval prior to use.
2. Pull/retrieval ropes.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that piping is ready for testing.
- C. Verify that trenches are backfilled.
- D. When pipe installation is complete the pipe shall be inspected by the ENGINEER for conformance with the provisions of the plans and specifications, particularly line and grade. Repair all visible and audible leaks.

#### 3.2 PREPARATION

- A. Section 017000 - Execution and Closeout Requirements
- B. Lamping:
  1. Lamp gravity piping after flushing and cleaning.
  2. Perform lamping operation by shining light at one end of each pipe section between manholes.
  3. Observe light at other end. Accepted sanitary sewer lines shall be free and clean from obstructions and exhibit a fully circular pattern.
  4. Pipe not installed with uniform line and grade will be rejected.
  5. Remove and reinstall rejected pipe sections.
  6. Clean and lamp until pipe section is installed to uniform line and grade.
- C. Plugs:
  1. Plug outlets, wye branches, and laterals.
  2. Brace plugs to resist test pressures.
  3. Plugs in sewers 18 inches in size and larger shall be connected by steel cable for thrust reaction.

### 3.3 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements:
- B. Section 017000 - Execution and Closeout Requirements:
- C. Testing shall be in accordance with authorities having jurisdiction. If there are no indicated testing requirements by authorities with jurisdiction, then Testing shall be in accordance with the below requirements.
- D. Deflection Testing of Plastic Sewer Piping:
  - 1. Perform vertical ring deflection testing on PVC gravity sewer piping in the presence of the ENGINEER or his representative.
  - 2. Initial inspection shall be conducted after backfilling has been in place for at least 30 days, but prior to final completion.
  - 3. Allowable maximum deflection for installed plastic sewer pipe is no greater than five percent of original vertical internal diameter.
  - 4. Perform deflection testing using "go, no go" mandrel.
  - 5. Mandrel Diameter:
    - a. Not less than 95 percent of base or average ID of pipe.
    - b. Pipe Diameter: Comply with ASTM D2122.
    - c. The chart that follows indicates the required mandrel diameter for specific sizes of SDR 35 PVC piping. The allowable deflection (less than 5 percent) for other pipe sizes and types shall be calculated using the pipe stiffness formula in ASTM D2321.

Nominal Pipe Size	Pipe I.D. (SDR 35)	Required Mandrel O.D.
8"	7.920"	7.28"
10"	9.900"	9.08"
12"	11.780"	10.79"
15"	14.426"	13.20"

- 6. The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe with only a nominal hand force applied. No mechanical device shall be used in pulling the mandrel.
- 7. Service lines need not be tested.
- 8. Any pipe which refuses the mandrel shall be removed and replaced by the CONTRACTOR at no additional cost. Such sections shall be re-tested for low-pressure air and for deflection 30 days after completion of trench backfill.
- 9. Mandrel testing may be performed by the OWNER at any time prior to the expiration of the one-year warranty. Any pipe which refuses the mandrel shall be replaced by the CONTRACTOR as described above at no cost to the OWNER.

END OF SECTION 330505.43



## SECTION 330507 – BORING AND JACKING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary for installing encasement pipe and carrier pipes under highways, railroads, streets, or other locations by the bore and jack method as specified herein.
2. Perform construction in a manner that will not interfere with the operation of any street, highway, railway, or other facility, and will not weaken or damage the roadbed or structure. Furnish and maintain barricades and lights to safeguard traffic and pedestrians as required by authorities having jurisdiction until such time as the operation has been completed.
3. The omission from the Drawings and Specifications of any details required for the satisfactory installation of the work in its entirety shall not relieve the CONTRACTOR of full responsibility for providing such necessary items.

##### B. Section Includes:

1. Casing and jacking pipe.
2. Excavation for approach trenches and pits.

#### 1.2 REFERENCE STANDARDS

##### A. American Association of State Highway and Transportation Officials:

1. AASHTO HB-17 - Standard Specifications for Highway Bridges.

##### B. American Railway Engineering and Maintenance-of-Way Association:

1. AREMA - Manual for Railway Engineering.

##### C. American Welding Society:

1. AWS D1.1 - Structural Welding Code – Steel.

##### D. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A139 - Standard Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C150 - Standard Specification for Portland Cement.

##### E. National Utility Contractors Association:

1. NUCA - Guide to Pipe Jacking and Microtunneling Design.

##### F. State of North Carolina Department of Transportation

1. Standard Specifications for Roads and Structures, latest revision
2. Policies and Procedures for Accommodating Utilities on Highway Rights of Way

- G. Occupational Safety and Health Administration
1. Safety and Health Regulations for Construction

### 1.3 COORDINATION

- A. For all work within the Department of Transportation right-of-way, notify the appropriate office of the Department of Transportation at least 72 hours prior to beginning construction.
- B. No blasting will be done without prior written approval of the Department of Transportation. If requested, furnish the Department of Transportation with details of the proposed blasting method.
- C. At all times, ensure the free and unobstructed use of the right-of-way for the passage of traffic without delay or danger to life, equipment, or property.

### 1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 – Administrative Requirements
- B. All parties, including the OWNER, ENGINEER, CONTRACTOR, installer, any subs, and the product manufacturer, shall meet prior to commencement of work to review the specification and discuss job specific expectations, needs and requirements.

### 1.5 SUBMITTALS

- A. Section 01 30 00 – Submittals
- B. Product Data: Submit product data on steel casing pipe, casing spacers, and end seal materials.
- C. Shop Drawings:
1. Indicate details of casing, jacking head, sheeting, and other falsework for trenches and pits, and support for excavation, field sketches, and other details to complete Work.
  2. Indicate relationship of proposed installation to existing facilities and/or natural features over installation, angle of installation, right-of-way lines, and general layout of built facilities.
  3. Indicate cross-section(s) from field survey, showing installation in relation to actual profile of ground.
  4. Submit description of proposed construction plan, dewatering plan, and plan to establish and maintain vertical and horizontal alignments.
- D. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for shoring and bracing.

- E. Submit emergency response procedures to handle situations when conduit is compromised and jeopardizes safety or integrity of installation.
  - 1. If any movement or settlement occurs which causes or might cause damage to existing facilities or structures over, along, or adjacent to the work, immediately stop any and all work except that which assists making the work secure and prevents further movement, settlement, or damage. Resume installation activities only after all necessary precautions have been taken to prevent further movement, settlement or damage, and repair the damage, at no additional cost to the OWNER, to the satisfaction of the ENGINEER.
- F. Submit written report results of visual check of entire length of casing prior to installation of carrier to verify that there are no voids or defective joints.
- G. Qualifications Statements:
  - 1. Submit qualifications for installer and licensed professional.
  - 2. Welders: Qualify procedures and personnel according to AWS D1.1.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of casing, carrier pipe, and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

#### 1.7 QUALITY ASSURANCE

- A. Perform Work according to AREMA, NUCA, OSHA, and AASHTO guidelines.
- B. Comply with all Federal, State, and local laws, ordinances, rules, and regulations affecting the work under this section.
- C. Where applicable, perform Work according to State of North Carolina Department of Transportation standards.
- D. All welding procedures used to fabricate and install steel casings shall be performed in accordance with the provisions of ANSI/AWS D1.1.

#### 1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience.
- B. Welders: AWS qualified by an independent local, approved testing agency within the previous 12 months for employed weld types.
  - 1. A minimum of 3 years recent experience within the last 5 years with welding procedures required on this project.

- C. Licensed Professional: Professional Engineer experienced in design of specified Work and licensed in State of North Carolina.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 – Product Requirements
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. If any defective material is discovered, remove it and replace with sound pipe or repair defective material in an approved manner and at the CONTRACTOR's expense.
- C. Handling: Support casing and carrier pipes with nylon slings during handling. Do not place pipe within pipe of a larger size and do not roll or drag pipe over gravel or rock.
- D. Storage:
  - 1. Store products according to manufacturer instructions.
  - 2. Use wooden shipping braces between layers of stacked pipe.
  - 3. Stack piping lengths no more than three layers high.
  - 4. Store field joint materials in original shipping containers.
  - 5. Do not store any plastic materials in direct sunlight.
- E. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide temporary end caps and closures on piping and fittings and maintain in place until installation.
  - 3. Protect piping system pieces from entry of foreign materials and water by installing temporary covers, completing sections of Work, and isolating parts of completed system.
  - 4. Provide additional protection according to manufacturer instructions.
- F. When any material is damaged during transporting, unloading, handling, or storing, the undamaged portions may be used as needed, or, if damaged sufficiently, the ENGINEER will reject the material as being unfit for installation.

#### 1.10 AMBIENT CONDITIONS

- A. Section 01 60 00 – Product Requirements
- B. Storage Temperature: Maintain 60 to 85 degrees F.

#### 1.11 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements
- B. All materials shall be warranted to be free from defects in workmanship and materials for one (1) year following final acceptance by the OWNER.



## 1.12 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 CASING AND JACKING PIPE

- A. Steel Casing Pipe:
  - 1. Comply with ASTM A139, Grade B.
  - 2. Minimum Yield Strength: 35,000 psi.
  - 3. Welded Joints:
    - a. Comply with AWS D1.1.
    - b. Full circumference.
  - 4. Interior and exterior coating.
    - a. Additional coating requirements, if any, may be included in the encroachment agreement. The encroachment agreement is included and made a part of the Contract Documents.
  - 5. Pipe Sizing:
    - a. The encasement pipe shall be of the diameter and wall thickness indicated on the drawings, but in no case shall they be less than required by authorities having jurisdiction.
- B. Performance and Design Criteria:
  - 1. Casing Pipe: Leakproof.
  - 2. Loading:
    - a. Highways:
      - 1) Earth cover.
      - 2) H-20 live loading, according to AASHTO HB-17.
      - 3) Impact loading according to AASHTO HB-17.
    - b. Railways:
      - 1) Earth cover.
      - 2) Comply with AREMA - Manual for Railway Engineering.
      - 3) Impact loading according to AREMA guidelines.
  - 3. Bracing, Backstops, and Jacks: Of sufficient rating for continuous jacking without stopping except to add pipe sections, and to minimize tendency of ground material to freeze around casing pipe.

### 2.2 CARRIER PIPE

- A. Site Water Distribution System Piping: As specified.
- B. Sanitary Sewage System Piping: As specified.

## 2.3 MATERIALS

- A. Soil Backfill for Trench Approaches and Pits to Finish Grade: Subsoil with no rocks 6 inches in diameter or greater, frozen earth, or foreign matter.
- B. Filling and Sealing Grout at Pipe Ends: Grout shall be a mixture of approximately one part cement, 1-1/2 parts sand, water reducing retarder and sufficient water to make a stiff workable mix.
- C. Pressure-Grout Mix: One part portland cement and two parts mortar sand, mixed with water to consistency applicable for pressure grouting.
- D. Mortar Sand: Comply with ASTM C33.
- E. Portland Cement:
  - 1. Portland cement shall be ASTM C150 Type II or Type V, containing less than 0.6 percent alkali.

## 2.4 ACCESSORIES

- A. Steel and Plastic Supports and Insulators:
  - 1. Bands: 14-gage stainless steel.
  - 2. Flange Bolts: 5/16-inch stainless steel.
  - 3. Liner: Heavy-duty PVC.
  - 4. Skids: UHMW Polyethylene.
    - a. Wood skids are not an acceptable method of supporting the carrier pipe.
  - 5. For Carrier Pipes up to 36 Inches in Diameter Conveying Water or Wastewater
    - a. Casing spacers shall be spaced a maximum of eight (8) feet apart along the length of the carrier pipe with one casing spacer within two (2) feet of each side of a pipe joint and the rest evenly spaced.
    - b. The casing spacer polymer shall contain ultraviolet inhibitors and shall have a minimum compressive strength of 3,000 psi, an 800 Volts/mil dielectric strength and impact strength of 1.5 ft-lbs/inch. Each casing spacer shall have full length, integrally molded skids extending beyond the bell or mechanical joint of the carrier pipe.
- B. Steel Strapping: Comply with ASTM A36.
- C. Casing End Seals
  - 1. Casing end seals shall be used to completely close both openings on either side of the casing.
  - 2. End seals shall be 1/8-inch thick synthetic rubber secured with stainless steel banding straps. Other end seals may be constructed only as pre-approved by the ENGINEER or as required by authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that connection to existing piping system, sizes, locations, and invert elevations are as indicated on Drawings.
- B. Examine the areas and conditions under which the boring is to be installed and become familiar with the conditions under which the work will be performed, all necessary details, and the suitability of the proposed equipment and methods for the orderly prosecution of the work.
- C. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.
- D. Notify the ENGINEER immediately if conditions do not permit a bore and jack installation.

### 3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Existing Utilities:
  - 1. Locate and identify utilities indicated to remain and protect from damage.
  - 2. Notify ENGINEER of any potential utility conflicts immediately.
  - 3. Establish minimum separation of proposed installation from existing utilities according to authorities having jurisdiction.
- C. Maintain access to existing facilities and other active installations requiring access.
- D. Furnish, install and remove, to the extent required, thrust blocks or whatever provisions may be required for driving the casings/sleeves and pipes forward.

### 3.3 INSTALLATION

- A. Safety:
  - 1. Provide all necessary bracing, bulkheads, and/or shields to ensure complete safety to all traffic at all times during the progress of the work, and perform the work in such a manner as to not interfere with normal traffic over the work.
- B. Dewatering:
  - 1. Intercept and divert surface drainage precipitation and ground water away from excavation through use of dikes, curb walls, ditches, pipes, sumps, or other methods.
  - 2. Develop substantially dry subgrade for subsequent operations.
  - 3. Comply with requirements of local and state authorities for dewatering to any watercourse, prevention of stream degradation, and erosion and sediment control.
  - 4. Keep all excavations free from ground and surface water during the operation and be prepared to implement groundwater control on short notice as directed by the

ENGINEER, even if observed water levels prior to construction are below the invert elevation of the casing pipe.

C. Pits or Approach Trenches:

1. Suitable pits or trenches shall be excavated for the purpose of jacking operations and for placing the end joints of pipe.
2. All excavations shall be protected with suitable fencing or barricades to prohibit unauthorized access to the work site.
3. Excavate approach trenches or pits as Site conditions require.
4. Ensure that casing entrance faces as near perpendicular in alignment as conditions permit.
5. Establish vertical entrance face at least 1 foot above top of casing.
6. Where necessary, trenches shall be securely sheeted and braced to prevent caving.
7. The pits or trenches shall be backfilled immediately after the operation has been completed.

D. Casing Pipe:

1. The driven portions of the casing shall be advanced from the lower end of the casing unless specific permission to do otherwise is obtained from the ENGINEER.
2. Boring:
  - a. Boring operations shall be continuous to their completion, and unnecessary or prolonged stoppages shall not be allowed to prevent the pipe from becoming firmly set in the embankment.
  - b. Steel rails or beams embedded in concrete shall be used in the pit for placement and alignment of each piece of casing during installation operations.
  - c. Push pipe into ground with boring auger rotating within pipe to remove soil.
  - d. Do not advance cutting head ahead of casing pipe, except for distance necessary to permit cutting teeth to maintain clearance for pipe.
  - e. Arrange machine bore and cutting head to be removable from within pipe.
  - f. Arrange face of cutting head to provide barrier to free flow of soft material.
  - g. If unstable soil is encountered during boring, retract cutting head into casing to permit balance between pushing pressure and ratio of pipe advancement to quantity of soil.
3. Abandonment of Bore: In the event that an obstruction is encountered during the dry boring operation, the casing shall be inspected by the ENGINEER and determined if it may be removed or left in place.
  - a. If an obstruction is encountered during the dry bore operation which prohibits further extending of the bore, terminate the bore if approved by ENGINEER as follows:
    - 1) Remove the boring auger and the casing pipe.
    - 2) Fill the void created by the removal of the pipe with grout as specified at a minimum pressure of 25 pounds per square inch.
    - 3) Provide suitable temporary forms to retain the grout within the limits of the former casing pipe.
    - 4) Remove forms after the grout has set.
    - 5) Move to another bore site as directed by the ENGINEER.
4. Jacking:
  - a. The pipe to be jacked shall be set on guides, braced together, to properly support the section of the pipe and direct it to the proper line and grade.
  - b. Construct adequate thrust wall normal to proposed line of thrust.

- c. Impart thrust load to pipe through suitable thrust ring sufficiently rigid to ensure uniform distribution of thrust load on full pipe circumference.
  - d. Remove any pipe damaged in boring and jacking operations and replace at no additional cost to the OWNER.
- E. Pressure Grouting: If voids in excess of 3-inch are encountered, install grout holes of a size suitable for injecting grout between casing pipe and surrounding earth.
  1. The grouting operation shall take place immediately after completion of the bore.
  2. Grout holes shall be installed at intervals not exceeding 10-feet.
  3. Inject grout into the void under sufficient pressure to prevent settlement.
  4. No additional compensation will be paid for grouting.
- F. Carrier Pipe:
  1. Clean, inspect, and handle pipe as specified.
  2. Prevent damage to pipe joints as carrier pipe is placed in casing.
  3. Supports:
    - a. Support pipeline within casing using skids or rollers such that no external loads are transmitted to carrier pipe.
    - b. Attach supports to barrel of carrier pipe; do not rest carrier pipe on bells.
    - c. No blocks or spacers shall be wedged between the carrier pipe and the top of the casing.
  4. The carrier pipe shall extend a minimum of 2 feet past casing pipe on each end.
  5. Install an end seal on each end of the casing pipe so that annular space between the casing and carrier pipe is sealed.

### 3.4 TOLERANCES

- A. Excavation:
  1. Minimize overbore by matching the cutter diameter to the diameter of the encasement pipe as closely as practicable. Do not overcut excavation by more than 1 inch greater than OD of casing pipe.
- B. The alignment and grade of the encasement pipe shall be carefully maintained and the encasement pipe installed in a manner that will allow the installation of the carrier pipe to the lines and grades shown on the plans.
- C. Casing Pipe Vertical and Horizontal Alignment:
  1. Horizontal: Variation in the final position of the pipe from the line and grade established by the ENGINEER will be permitted only to the extent of 0.5% in lateral alignment.
  2. Vertical Alignment: Where the carrier pipe is to be laid on a uniform grade (i.e. gravity sewer line or gravity storm drain) the variation in vertical alignment will be as follows:

Carrier Pipe Size	% Grade Tolerance
8	±0.04
10	±0.028
12	±0.022

14	±0.017
15	±0.015
16	±0.014
18	±0.012
20	±0.01
21	±0.01
24	±0.008
27	±0.0067
30	±0.0058
33	±0.0052
36	±0.0046

3. In no instance shall the grade of the carrier pipe be less than the minimum grade required by OWNER or State Regulations.

D. Pipe Bells: Minimum 1/2-inch clearance to casing.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer Services: Furnish services of manufacturer's representative experienced in use of equipment and installation of products furnished under this Section as necessary to ensure compliance with the requirements of this Section throughout the course of the work.

### 3.6 CLEANING

- A. 015000 – Temporary Facilities and Controls.
- B. Remove temporary facilities for casing installation and jacking operations.
- C. Repair all damage and restore the property to its original condition.

### 3.7 PROTECTION

- A. Protect plant life, lawns, rock outcroppings, and other features of final landscaping.
- B. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

END OF SECTION 330507.36

## SECTION 330507.13 - UTILITY DIRECTIONAL DRILLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary for directional drilling under highways, railroads, streets, or other locations as specified herein.
2. Perform construction in a manner that will not interfere with the operation of any street, highway, railway, or other facility, and will not weaken or damage the roadbed or structure. Furnish and maintain barricades and lights to safeguard traffic and pedestrians as required by authorities having jurisdiction until such time as the operation has been completed.
3. The omission from the Drawings and Specifications of any details required for the satisfactory installation of the work in its entirety shall not relieve the CONTRACTOR of full responsibility for providing such necessary items.

##### B. Section Includes:

1. Excavation for approach trenches and pits.
2. Horizontal directional drilling.
3. Pipe.
4. Drilling fluid system.

#### 1.2 REFERENCE STANDARDS

##### A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

##### B. American Water Works Association:

1. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
2. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
3. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
4. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission.

##### C. ASTM International:

1. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft<sup>3</sup>).
  2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>).
  3. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
  4. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
  5. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
  6. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
  7. ASTM D2464 - Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  8. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
  9. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
  10. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
  11. ASTM D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
  12. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
  13. ASTM D3035 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
  14. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
  15. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
  16. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
  17. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
  18. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.
  19. ASTM F1056 - Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings.
  20. ASTM F1962 - Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.
- D. North American Society for Trenchless Technology:
1. NASTT - Horizontal Directional Drilling Good Practices Guidelines.
- E. Plastics Pipe Institute:



1. PPI TR-46 - Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of High Density Polyethylene Pipe.

### 1.3 COORDINATION

- A. For all work within the Department of Transportation right-of-way, notify the appropriate office of the Department of Transportation at least 72 hours prior to beginning construction.
- B. No blasting will be done without prior written approval of the Department of Transportation. If requested, furnish the Department of Transportation with details of the proposed blasting method.
- C. At all times, ensure the free and unobstructed use of the right-of-way for the passage of traffic without delay or danger to life, equipment, or property.
- D. Coordinate Work of this Section with authorities having jurisdiction and utilities within construction area.

### 1.4 PREINSTALLATION MEETINGS

- A. Section 013000 - Administrative Requirements: Requirements for preinstallation meeting.
- B. All parties, including the OWNER, ENGINEER, CONTRACTOR, installer, any subs, and the product manufacturer, shall meet prior to commencement of work to review the specification and discuss job specific expectations, needs and requirements.

### 1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
  1. Identify source of water used for drilling.
  2. Submit copy of approvals and permits for use of water source.
- C. Shop Drawings:
  1. Submit technical data for equipment, method of installation, and proposed sequence of construction.
  2. Include information pertaining to pits, dewatering, method of spoils removal, and equipment size, capacity, and capabilities, including installing pipe on radius, type of drill bit, drilling fluid, method of monitoring line and grade, detection of surface movement, name plate data for drilling equipment, and mobile spoils removal unit.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- E. Field Quality-Control Submittals: Indicate results of CONTRACTOR-furnished tests and inspections.
- F. Qualifications Statement:
  - 1. Submit qualifications for driller.
- G. Obtain and submit any required occupancy permit for installations along or under public thoroughways and lands.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of pipe invert and centerline elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- D. Record actual depth of pipe at 25 -foot intervals.
- E. Record actual horizontal location of installed pipe.
- F. Show depth and location of abandoned bores.
- G. Record depth and location of drill bits and drill stems not removed from bore.

#### 1.7 QUALITY ASSURANCE

- A. Perform Work according to following:
  - 1. NASST - Horizontal Directional Drilling Good Practices Guidelines.
  - 2. ASTM F1962.
  - 3. PPI TR-46.
- B. Perform Work according to authority having jurisdiction standards.

#### 1.8 QUALIFICATIONS

- A. Driller: Company specializing in performing Work of this Section with minimum three years' documented experience.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Handling:
  - 1. Use shipping braces between layers of stacked pipe.
  - 2. Support pipes with nylon slings during handling.
- D. Storage:
  - 1. According to manufacturer instructions.
  - 2. Stack piping lengths no more than three layers high.
  - 3. Store field joint materials in original shipping containers in dry area indoors.
- E. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Protect pipe from entry of foreign materials and water by installing temporary covers, completing sections of Work, and isolating parts of completed system.
  - 3. Provide additional protection according to manufacturer instructions.

#### 1.10 AMBIENT CONDITIONS

- A. Section 015000 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Maintain storage temperature of 60 to 85 degrees F.

#### 1.11 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 HORIZONTAL DIRECTIONAL DRILLING

- A. Performance and Design Criteria:
  - 1. Drilling Steering System: Remote with continuous electronic monitoring of boring depth and location.
  - 2. Directional Change Capability: 90 degrees with 35-foot radius curve.
  - 3. Minimum distance for single bores and between boring pits:

- a. Pipe Size 1 to 1-1/2 Inches: 400 feet.
  - b. Pipe Size 2 to 2-1/2 Inches: 350 feet.
  - c. Pipe Size 3 to 6 Inches: 300 feet.
  - d. Pipe Size > 6 inches: in accordance with manufacturer recommendations.
4. Ratio of Reaming Diameter to Pipe OD:
  - a. Nominal Pipe Diameter of 6 Inches and Smaller: Maximum of 1.5.
  - b. Nominal Pipe Diameter Larger Than 6 Inches: Submit recommended ratio and reaming procedures for review by ENGINEER.
- B. Water Source:
  1. Potable.
  2. CONTRACTOR shall determine water source and provide documentation from OWNER permitting use.
- C. Materials:
  1. Drilling Fluid: Liquid bentonite clay slurry; totally inert with no environmental risk.
- D. PVC Piping:
  1. Pipe: Comply with AWWA C900, Class 235.
  2. Materials:
    - a. Comply with ASTM D1784.
    - b. Minimum Cell Classification: 12545-C.
  3. Fittings: Comply with AWWA C111, cast iron.
  4. Joints:
    - a. Comply with ASTM D3139.
    - b. Seal: Compression gasket ring.
- E. Polyethylene (PE) Piping:
  1. Pipe: Comply with AWWA C901 or AWWA C906, according to pipe sizes proposed on plan...
  2. Materials:
    - a. Comply with ASTM D3350.
    - b. Minimum Cell Classification: 324433-C.
  3. Fittings:
    - a. Comply with AWWA C901 or C906, according to pipe sizes proposed on plans.
    - b. Style: Molded or fabricated.

4. Joints:

- a. End Connections: Socket, solvent welded; ASTM D2855 threaded or flanged.

- F. Subsoil Fill: Excavated and reused soil with no rocks more than 6 inches in diameter, frozen earth, or foreign matter.

2.2 MIXES

- A. Grout: –In accordance with manufacturer recommendations.  
B. Flowable Fill: In accordance with manufacturer recommendations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that connections to existing piping system, sizes, locations, and invert centerline elevations are according to Drawings.  
B. Examine the areas and conditions under which the direction drill is to be installed and become familiar with the conditions under which the work will be performed, all necessary details, and the suitability of the proposed equipment and methods for the orderly prosecution of the work.  
C. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.  
D. Notify the ENGINEER immediately if conditions do not permit a directional drill installation.

3.2 PREPARATION

- A. Local Utility:  
1. Call local utility line information service at 811 not less than three working days before performing Work.  
2. Request underground utilities to be located and marked within and surrounding construction areas.  
B. Maintain access to existing facilities, services and other items indicated to remain; modify pipe installation indicated on Drawings to maintain access to existing facilities. The CONTRACTOR shall obtain ENGINEER approval prior to any proposed modifications.  
C. Locate and identify utilities indicated to remain and protect from damage.  
D. Identify required lines, levels, contours, and data locations.

- E. Protect plant life, lawns, and other features remaining as portion of final landscaping.
- F. Protect benchmarks such as existing structures fences sidewalks paving curbs and survey control points from excavating equipment and vehicular traffic.
- G. Establish pipe elevations with not less than three feet of cover.
- H. Establish minimum separation between utilities as indicated on the Drawings and in accordance with authorities having jurisdiction.

### 3.3 INSTALLATION

#### A. Dewatering:

- 1. Intercept and divert surface drainage, precipitation, and ground water away from excavation using dikes, curb walls, ditches, pipes, sumps, or other approved means.
- 2. Develop and maintain substantially dry subgrade during drilling and pipe installation.
- 3. Comply with authorities having jurisdiction requirements for discharging water to watercourse, preventing stream degradation, and controlling erosion and sediment.

#### B. Excavation:

- 1. Excavate approach trenches and pits according to Drawings and as Site conditions require; minimize number of access pits.
- 2. Provide sump areas to contain drilling fluids.
- 3. Install excavation supports as required by authorities having jurisdiction.
- 4. Restore areas after completion of drilling and carrier pipe installation.

#### C. Drilling:

- 1. Drill pilot bore with vertical and horizontal alignment as indicated on Drawings.
- 2. Surveying:
  - a. Survey entire drill path and mark entry and exit locations with stakes.
  - b. If a magnetic guidance system is used, survey drill path for surface geomagnetic variations or anomalies.
- 3. Guiding:
  - a. Guide drill remotely from ground surface to maintain alignment by monitoring signals transmitted from drill bit.
  - b. Monitor depth, pitch, and position.
  - c. Adjust drill head orientation to maintain correct alignment.
- 4. Drilling Fluid:
  - a. Inject drilling fluid into bore to stabilize hole, remove cuttings, and lubricate drill bit and pipe.

- b. Continuously monitor drilling fluid pumping rate, pressure, viscosity, and density while drilling pilot bore, back reaming, and installing pipe to ensure adequate removal of soil cuttings and stabilization of bore.
  - c. Provide relief holes when required to relieve excess pressure.
  - d. Minimize heaving during pullback.
- 5. Verification of Accuracy:
  - a. Calibrate and verify electronic monitor accuracy during first 50 feet of bore in presence of ENGINEER before proceeding with other drilling.
  - b. Excavate minimum of four test pits spaced along first 50 feet of bore to verify required accuracy.
  - c. If required accuracy is not met, adjust equipment or provide new equipment capable of meeting required accuracy.
- 6. After completing pilot bore, remove drill bit.

D. Drilling Obstructions:

- 1. If obstructions are encountered during drilling, notify ENGINEER immediately.
- 2. Do not proceed around obstruction without approval of ENGINEER.
- 3. For conditions requiring more than 3 feet of deviation in horizontal alignment, submit revised Shop Drawings to ENGINEER for approval before resuming Work.
- 4. Maintain adjusted bore alignment within easement or right-of-way.

E. Piping:

- 1. Install reamer and pipe pulling head; select reamer with minimum bore diameter required for pipe installation.
- 2. Attach pipe to pipe pulling head and pull reamer and pipe to entry pit along pilot bore.
- 3. Inject drilling fluid through reamer to stabilize bore and lubricate pipe.
- 4. Install piping with horizontal and vertical alignment as shown on Drawings.
- 5. Protect and support pipe being pulled into bore such that pipe moves freely and is not damaged during installation.
- 6. Do not exceed pipe manufacturer's recommended pullback forces.
- 7. Trace Wire:
  - a. Install trace wire continuous with each bore.
  - b. Splice trace wire only at intermediate bore pits.
  - c. Tape or insulate trace wire to prevent corrosion and maintain integrity of pipe detection.
  - d. Terminate trace wire for each pipe run at structures along pipe system.
  - e. Provide extra length of trace wire at each structure such that trace wire can be pulled 3 feet out top of structure for connection to detection equipment.
  - f. Test trace wire for continuity for each bore before acceptance.
- 8. Provide sufficient length of pipe to extend past termination point to allow connection to existing.

9. Allow minimum of 24 hours for stabilization after installing pipe before making connections to pipe.
10. Mark location and depth of bore with spray paint on paved surfaces and on wooden stakes on non-paved surfaces at 25-foot intervals.

F. Slurry Removal and Disposal:

1. Contain excess drilling fluids at entry and exit points until recycled or removed from Site; provide recovery system to remove drilling spoils from access pits.
2. Drilling Spoils:
  - a. Remove, transport, and legally dispose of drilling spoils.
  - b. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems.
  - c. When drilling in suspected contaminated soil, test drilling fluid for contamination before disposal.
3. If drilling fluid leaks to surface, immediately contain leak and barricade area from vehicular and pedestrian travel before resuming drilling operations.
4. Complete cleanup of drilling fluid at end of each working day.

G. Backfilling:

1. Install backfill as specified in Section 331413.00
2. Backfill approach trenches and pits with subsoil fill to contours and elevations as indicated on Drawings.
3. Compact subsoil fill to minimum 95 percent of maximum density.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Horizontal Position: 12 inches.
- C. Maximum Variation from Vertical Elevation: 2 inches.
- D. Minimum Horizontal and Vertical Clearance from Other Utilities: 12 inches.
- E. Deviation:
  1. If pipe installation deviates beyond specified tolerances, abandon bore, remove installed pipe, rebore, and reinstall pipe in correct alignment.
  2. Fill abandoned bores greater than 3 inches in diameter with grout or flowable fill material.



### 3.5 FIELD QUALITY CONTROL

- A. Upon completion of pipe installation, test pipe according to following:
  - 1. Sanitary Sewer Pipe Testing: As specified in Section 330505.31 - Hydrostatic Testing 330505.43 - Mandrel Testing.
  - 2. Water Distribution Pipe Testing: As specified in Section 331413 - Public Water Utility Distribution Piping.
  - 3. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- B. Compaction Testing:
  - 1. Comply with ASTM D698.
  - 2. Compact pipe bedding and embedment material to 95% Standard Proctor.
  - 3. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- C. Certify that equipment for drilling has been properly set up and is ready for drilling.

### 3.6 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Upon completion of drilling and pipe installation, remove drilling spoils, debris, and unacceptable material from approach trenches and pits.
- C. Clean up excess slurry from ground.
- D. Restore approach trenches and pits to original condition.
- E. Remove temporary facilities for drilling operations.

END OF SECTION 330507.13



## SECTION 330561 - CONCRETE MANHOLES

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to install sanitary sewer manholes and appurtenances in accordance with the plans. All materials shall be of the type and class specified herein.

##### B. Section Includes:

1. Modular precast concrete manholes and structures with tongue-and-groove joints and transition to cover frame, covers, anchorage, and accessories.
2. Masonry manhole and structure sections with masonry transition to cover frame, covers, anchorage, and accessories.
3. Cast-in-place concrete manholes and structures with transition to cover frame, covers, anchorage, and accessories.
4. Doghouse manhole connections to existing sanitary or storm sewer lines.
5. Bedding and cover materials.
6. Pile support systems.
7. Vertical adjustment of existing manholes and structures.

#### 1.02. DEFINITIONS

- ##### A. Bedding: Specialized material placed under manhole prior to installation and subsequent backfill operations.

#### 1.03. REFERENCE STANDARDS

##### A. American Association of State Highway Transportation Officials:

1. AASHTO M91 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
2. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
3. AASHTO M306 - Standard Specification for Drainage, Sewer, Utility, and Related Castings.

##### B. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.

##### C. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

3. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).
4. ASTM C361 - Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
5. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
6. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
7. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
8. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
9. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
10. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
11. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
12. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

1.04. COORDINATION

- A. Coordinate Work of this Section with OWNER and ENGINEER

1.05. SUBMITTALS

- A. Section 01 30 00 - Electronic Submittals.
- B. Product Data: Submit manufacturer information for manhole covers, component construction, features, configuration, and dimensions.
- C. Shop Drawings:
1. Indicate structure locations and elevations.
  2. Indicate sizes and elevations of piping, penetrations, and other appurtenances.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

1.06. CLOSEOUT SUBMITTALS

- A. Section 01 72 00 - Project Record Documents.
- B. Project Record Documents: Record actual locations of manholes and connections, and record invert elevations.

1.07. QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.08. DELIVERY, STORAGE, AND HANDLING

- A. Section 01 55 00 - Site Access and Storage.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Handling: Comply with precast concrete manufacturer instructions and ASTM C913 for unloading and moving precast manholes and drainage structures.
- D. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Store precast concrete manholes and drainage structures to prevent damage to OWNER's property or other public or private property.
  - 3. Repair property damaged from materials storage.
- E. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

1.09. AMBIENT CONDITIONS

- A. Cold Weather Requirements: Comply with ACI 530/530.1.

1.10. EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

1.11. WARRANTY

- A. Furnish five-year manufacturer's warranty for concrete manholes.

PART 2 PRODUCTS

2.01. PRECAST CONCRETE MANHOLES

- A. Manufacturers:
  - 1. Precast manholes shall be manufactured by Stay-Right Precast, Hanson Building Products, Oldcastle Pre-cast, Mack Industries, Tindall Corporation, or approved equal.
- B. Manhole Sections:
  - 1. General:
    - a. All manholes shall be constructed to the sizes, shapes, and dimensions and at the locations shown on the plans.

- b. Tapered section and transition sections, where required, shall be of eccentric cone design, having the same wall thickness and reinforcement as the cylindrical ring sections.
    - 1) Eccentric cone sections shall have a height of between 2 feet and 4 feet.
  - c. Flat slab tops shall be required for very shallow manholes as shown or specified. Flat slab tops shall ONLY be utilized when/where approved for use by the ENGINEER.
  - d. The quality of materials, the process of manufacture, and the finished manhole sections shall be subject to inspection and approval by the ENGINEER. The manhole sections shall be perpendicular to their longitudinal axis.
2. Precast Concrete:
- a. Comply with ASTM C478.
  - b. Compressive Strength: 4,000 psi minimum at 28 days complying with ACI 318, and ACI 350.
  - c. Maximum permissible absorption: 6 percent.
  - d. Cement: Comply with ASTM C150, Type II.
  - e. Aggregates: Fine aggregate shall be sand, while coarse aggregate shall be crushed gravel, both in accordance with ASTM C33.
  - f. Water: potable.
  - g. Reinforcement:
    - 1) The manhole sections shall have reinforcement as required to provide resistance to the hydrostatic and passive earth pressures to which they will be subjected, and to provide adequate resistance to temperature and shrinkage cracking.
    - 2) Bases and risers shall be reinforced with a single cage of steel placed within the center third of the wall.
    - 3) Welded wire fabric shall be in accordance with ASTM A185.
    - 4) Steel reinforcing bars shall be grade 60 deformed steel in accordance with ASTM A615.
    - 5) The tongue or the groove of the joint shall contain one (1) line of circumferential reinforcement equal in area to that in the barrel of the manhole riser.
    - 6) The minimum cross-sectional area of steel per linear foot shall be 0.12 square inches. Precast manhole sections shall fit together readily.
3. Thickness:
- a. Unless otherwise shown on the plans, manhole diameters, wall thicknesses and bottom thicknesses shall be as follows in the table. Cone sections shall have a minimum wall thickness of 8 inches at their top.

Pipe Size (inches)	Diameter (feet)	Wall Thickness (inches)	Bottom Thickness (inches)
8 through 18	4	5	6
21 through 36	5	5	8
39 through 54	6	6	8
Larger than 54	8	8	8

4. Base:

- a. Suitable openings for inlet and outlet pipes shall be cast into the base section for standard connections and into the riser section for drop connections. These openings shall be circular, accurately located and appropriately sized for each manhole.
- b. All manhole and wet well bases shall be monolithically poured complete with a bottom
- c. When indicated on the drawings, precast concrete base sections shall be provided with extended base sections or increased bottom thickness to provide ballast to prevent flotation. Extended bases, as required by the drawings, may be included in the monolithic pour of the base, or integrally cast as approved by the ENGINEER.

5. Height:

- a. The height or depth of each manhole will vary with the location, but unless otherwise indicated, it shall be constructed such that the top of the manhole matches that of the finished grade surrounding the manhole and the invert is constructed at elevation shown on the plans.
- b. As directed by the ENGINEER (or as otherwise indicated on the plans) the top elevations of some manholes maybe elevated above the finished grade of the surrounding area in wooded or other natural (unmaintained) areas.
- c. In all cases, the number of manhole sections (joints) necessary to construct the required height shall be minimized.

6. Joints:

- a. Comply with ASTM C913.
- b. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.

7. Gaskets: Comply with ASTM C443.

C. Clay Brick Units:

1. Comply with ASTM C32.
2. Grade: MS.
3. Configuration: Solid.

- D. Mortar and Grout:
  - 1. Mortar: Comply with ASTM C270, type M.
  - 2. Grout: Non-shrink, comply with CRD-C 621 or ASTM C1107
- 2.02. FRAMES AND COVERS
  - A. Manufacturers:
    - 1. Manhole frame and cover shall be manufactured by U.S. Foundry (USF 669 ring and KL cover), East Jordan Iron Works, Neenah Foundry or approved equal.
  - B. Description:
    - 1. Material:
      - a. Cast iron: Comply with ASTM A48
      - b. Comply with AASHTO M306 and HS20 if installed within roadways.
      - c. Comply with NCDOT 840.54 if installed within state-maintained roadways.
      - d. The manufacturer shall furnish certified tensile test results performed by an independent testing laboratory, if requested by the ENGINEER.
      - e. All castings shall be true to manufacturer's approved submittal drawings. Actual dimensions of all castings shall have a tolerance of  $\pm 1/16"$ , and an additional 1/16-inch per foot of dimension. All casting components of the same part number shall be interchangeable.
      - f. All castings shall be free from blowholes, shrinkages, or other surface imperfections.
    - 2. Frame:
      - a. Standard casting shall be designed for heavy duty use and 190 pounds.
      - b. The minimum opening within the interior of the frame shall be 22-inches.
      - c. Height of the manhole frame shall be 7½ inches.
      - d. The frame shall have a 4-inch minimum width flange
      - e. The frame shall have four (4) 1-inch diameter holes and shall be anchored to the precast concrete cone with stainless steel anchors and sealed with Butyl mastic rope.
    - 3. Lid:
      - a. Standard casting shall be designed for removable and heavy duty use and shall be 125 pounds.
      - b. Lid shall be 23.5-inches in diameter
      - c. Lid shall include an indented top design with lettering cast into the cover, including the name of the manufacturer, the part number, country of origin, and an appropriate description such as one of the following:
        - 1) RECLAIMED WATER
        - 2) SANITARY SEWER



3) STORM SEWER

4) WATER

5) OTHER APPROPRIATE WORDING

- d. Lids shall have two non-penetrating pickholes or pick slots.
- e. Security: as indicated on Drawings.
- 4. All manhole rings and covers shall be furnished with machined seating surfaces. Prior to shipping, the manufacturer shall fit up all casting components to ensure that all castings furnished are of proper fit and free from rattle.
- 5. Special waterproof manhole frame and covers shall be installed only at those locations indicated on the contract drawings.
  - a. Manhole frames and covers shall be made watertight by installing a rubber O-ring gasket seal or a side seal gasket and installing either four countersunk stainless-steel hex head bolts with rubber gaskets or use a cam-loc style ring and cover.
  - b. Watertight rings and lids shall be U.S. Foundry 669-KL-BWTL with a 125-pound cover or approved equal.

2.03. RISER RINGS

A. Description:

- 1. Precast reinforced concrete grade rings or brick shall be used to adjust ring and covers to finished grade.

B. Precast Riser Rings:

- 1. Comply with ASTM C478.
- 2. No more than 12 vertical inches of grade rings or brick will be allowed per manhole.
- 3. Grade rings shall be no less than 6 inches and no more than 9 inches in height with a diameter matching that of the frame and cover.
- 4. Rubber Seal Wraps:
  - a. Wraps and Band Widths: Comply with ASTM C877, Type III.
  - b. Cone/Riser Ring Joint: Minimum 3-inch overlap.
  - c. Frame/Riser Ring Joint: 2-inch overlap.
  - d. Additional Bands: Overlap upper band by 2 inches.

2.04. MANHOLE OPENINGS

- A. Precast utility structures shall be furnished with water stops, sleeves and openings as noted on the Drawings.
- B. Manhole openings shown on the drawings shall be cast in place unless otherwise noted.
- C. All penetrations needed though not shown on drawings shall be mechanically cored and installed with approved flexible watertight connector.

2.05. FLEXIBLE PIPE BOOTS FOR MANHOLE PIPE ENTRANCES

A. Manufacturers:

1. Connector shall be the PSX Direct Drive assembly by Press-Seal Gasket Corporation, the Kor-N-Seal I 106-406 Series by Trelleborg Pipe Seals or approved equal.
2. Furnish materials according to ASTM C923.

B. Description:

1. Material: EPDM or material approved by ENGINEER.
2. Comply with ASTM C923.
3. Attachment: stainless-steel clamp and hardware.
4. Deflection: permit at least an 7° deflection from the centerline of the opening in any direction while maintaining a watertight connection.
5. Seal: Joints shall be watertight under 30 feet of water in straight alignment for 10 minutes.
6. Seal: Joints shall be watertight under 23 feet of water at 7° deflection for 10 minutes.

2.06. ACCESSORIES

A. Steps:

1. Steps shall be a copolymer polypropylene plastic reinforced grade 60 bar and have serrated tread and tall end lugs.
2. Step pull out strength shall be a minimum of 2,000 pounds when tested according to ASTM C497. Each step shall also have a vertical load resistance of 400 pounds.
3. Steps shall be required in all structures with a depth greater than four (4) feet. Steps shall be vertically aligned and uniformly spaced for the entire depth of the structure. Steps shall be located in the structures along the vertical face of the eccentric cone and so as to land upon a bench.
4. Secure steps to the wall with a compression fit in tapered holes. Steps shall not be vibrated or driven into freshly cast concrete. Steps shall not be grouted in place.
5. Diameter: ½ inch.
6. Width: Minimum 12 inches.
7. Spacing: Between 12 and 16 inches o.c. vertically, set into structure wall.
8. Protrusion: Between 5 and 7 inches.

B. Concrete Section Joint Sealant

1. Manufacturers:

- a. Compound shall be NPC Bidco C-56 Butyl Joint Sealant, Henry Company Butyl-Nek Preformed Plastic Joint Sealant (BN109), Conseal CS-102, or approved equal.

2. Description:

- a. Comply with ASTM C990 and Federal Specification SS-S210A, AASHTO M-198, Type B - Butyl Rubber

b. Joints shall be sealed by two (2) butyl rubber seals. Each seal shall be as described below:

- 1) 1. Butyl Seals shall consist of a plastic or paper-backed butyl rubber rope no less than 1-inch cross section.
- 2) When manholes are larger than 4 feet diameter or have a larger than normal space between the joints, the length and or diameter of the rope shall be increased as required to achieve a seal.
- 3) Butyl rubber shall be applied to clean, dry surfaces only.
- 4) Use of 2 independent wraps of Butyl Rubber placed side-by-side (not stacked) qualifies for the requirement of two seals.

c. Internal O-Ring Gaskets and Internal Rubber Gaskets shall not be used.

C. Watertight Exterior Joint Seal

1. Manufacturer:

- a. Asphalt sealant shall be Carboline, Bitumastic 300m; Tnemec, Tneme-Tar; or approved equal.

2. Description:

- a. Watertight exterior joint seal shall be installed after joining manhole sections as specified herein.
- b. Butyl joint wrap shall be minimum width 12-inches and comply with ASTM C877.

D. Fasteners: Stainless steel; ASTM F593.

E. Concrete: As specified.

F. Manhole Vents:

1. Where designated on the contract drawings, a 4-inch diameter vent pipe shall be installed as an integral part of the manhole.
2. Material: Schedule 40 steel or as required by the Owner.
3. Coating: a 3/32-inch-thick coal tar interior lining and have an exterior finish consisting of two (2) coats of epoxy paint as approved by the ENGINEER.
4. The vent pipe is to be tapped into the upper most section of the manhole, anchored in concrete and extended vertically to the elevation shown on the drawings.
5. The pipe shall have a reverse bend and screen to prohibit rain and foreign materials from entering pipe.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify that built-in items are in proper location and are ready for roughing into Work.

- C. Verify that excavation base is ready to receive Work and excavations and that dimensions and elevations are as indicated on Drawings.
- 3.02. PREPARATION
- A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
  - B. Coordinate placement of inlet and outlet pipe as required by other Sections.
  - C. Do not install manholes and structures where Site conditions induce loads exceeding structural capacity of manholes or structures.
  - D. Inspect precast concrete manholes and structures immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.
- 3.03. INSTALLATION
- A. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas.
  - B. Correct over-excavation with coarse aggregate.
  - C. Remove large stones or other hard matter impeding consistent backfilling or compaction.
  - D. Protect manhole from damage or displacement while backfilling operation is in progress.
  - E. Excavating:
    - 1. Excavate in indicated locations and depths.
    - 2. Provide clearance around sidewalls of manhole or structure for construction operations and granular backfill.
    - 3. If ground water is encountered, prevent accumulation of water in excavations, place manhole or structure in dry trench.
    - 4. Where possibility exists of watertight manhole or structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by ENGINEER.
  - F. Base and Alignment:
    - 1. The manhole foundation shall be prepared so as to provide a firm, level area on which to place the precast concrete manhole base section.
    - 2. Install manholes supported at proper grade and alignment on 8-inch of No. 57 stone, or as indicated on Drawings.
    - 3. When poor foundation soil is encountered or excess groundwater exists, the foundation shall be excavated 12 inches or greater below the final subgrade elevation, as determined by the ENGINEER and backfilled with washed stone to provide a proper foundation.
    - 4. Form and place manhole or structure cylinders plumb and level, to correct dimensions and elevations.
  - G. Backfilling: As specified.

H. Coating: Interior coating not required unless otherwise specified.

I. Precast Concrete Manholes:

1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
3. Assembly:
  - a. Assemble multi section manholes and structures by lowering each section into excavation.
  - b. Install rubber gasket joints between precast sections according to manufacturer recommendations.
  - c. Lower, set level, and firmly position base section before placing additional sections.
4. Remove foreign materials from joint surfaces and verify that sealing materials are placed properly.
5. Maintain alignment between sections by using guide devices affixed to lower section.
6. Joint sealing materials may be installed on Site or at manufacturer's plant.
7. Unroll the butyl sealant directly against the base of the spigot. Leave protective wrapper attached until sealant is entirely unrolled against spigot. Do not stretch. Overlap from side to side - not top to bottom.
8. Verify that installed manholes meet required alignment and grade.
9. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
10. Cut pipe flush with interior of structure.
11. Inverts and Benches:
  - a. Manhole inverts and benches shall be constructed of brick and cement grout or precast concrete in accordance with the standard details shown on the drawings.
  - b. Inverts shall have a "U" shaped cross section of the same diameter as the invert of the sewers which they connect. "U" shaped inverts shall be constructed to a minimum depth of 6 inches for 8-inch sewers and to full pipe diameter depth of the outlet sewer main for larger mains.
  - c. The manhole invert shall be carefully formed to the required size and grade by gradual and even changes in sections.
  - d. Changes in direction of flow through the manhole, whether horizontal or vertical, shall be made with true tangent curve(s) with as large a radius as the size of the manhole will permit. Provide a ½-inch radius at the intersection of 2 or more channels.
  - e. Manhole benches shall be constructed with a slope of 1-inch per foot (8 percent) sloped toward the invert channel. Finish benches shall provide a uniform slope from the high point at the manhole wall to the low point at invert channel. Provide

a radius (1/8-inch to 1-inch range is acceptable) at the edge of the bench and channel.

- f. When the invert and bench are not constructed by the precast manufacturer, the CONTRACTOR shall construct the invert and bench using 3,000 psi concrete or non-shrink grout. Non-shrink grout may be plastered over layered brick and mortar in lieu of solid non-shrink grout invert.
- g. Gradual smooth sided depressions and high spots may be allowed so long as diameter of invert channel ranges from 1/4-inch less than, or 1/2-inch more than the nominal pipe diameter are maintained. Voids, chips, or fractures over 1/8-inch in diameter or depth shall be filled with a non-shrink grout and finished to a texture reasonably consistent with the bench surface. All work from collar down shall have a steel trowel finish.

12. Pipe Openings:

- a. Pipe openings shall provide clearance for pipe projecting a minimum of 2 inches inside the manhole. The crown of smaller diameter pipes shall be no lower than the crown of the outlet pipe. Grout pipe penetrations, including pipe crown, to provide a smooth, uniform finish using non-shrink grout.
- b. Pipe openings shall be exactly aligned to that of the pipe entering and leaving the manhole. The gravity sanitary sewer pipelines shall be placed in the manhole openings, properly aligned, and set to grade. Sanitary sewer shall be connected to the manholes using flexible manhole sleeves as described herein.
- c. For large diameter pipe where a flexible rubber sleeve is not available, the pipeline shall be sealed into the manhole using an expanding type or non-shrink type grout.

J. Doghouse Manholes and Structures:

- 1. Stake out location and burial depth of existing sewer line in area of proposed manhole.
- 2. Carefully excavate around existing sewer line to adequate depth for foundation slab installation.
- 3. Protect existing pipe from damage.
- 4. Cut out soft spots and replace with granular fill compacted to 95 percent maximum density.
- 5. Bear firmly and fully on compacted crushed stone bedding or support system as indicated on Drawings.
- 6. Install manhole or structure around existing pipe according to applicable Paragraphs in this Section.
- 7. Grout pipe entrances as specified.
- 8. Coordinate connection existing pipe with OWNER and ENGINEER.
- 9. Block upstream flow at existing manhole or structure with expandable plug.
- 10. Use hydraulic saw to cut existing pipe at manhole or structure entrance and exit and along pipe length at a point halfway up OD on each side of pipe.
- 11. Bottom half of pipe is to remain as manhole flow channel.

12. Saw cut to smooth finish with top half of pipe flush with interior of manhole or structure.
13. Grout base of manhole or structure to achieve slope to manhole or structure channel and trowel smooth.

K. Sanitary Manhole Drop Connections:

1. Standard drop manholes will be constructed only at those locations shown on the drawings or as approved by the ENGINEER.
2. The design of the drop connection shall be in accordance with the standard detail drawing.
3. The cost of the extra pipe, labor, etc. required to construct a drop manhole will be included in the unit price for the drop manhole at the depths indicated.

L. Castings:

1. Set the manhole frames to the required elevation using no more than 12 inches of precast concrete grade rings, or bricks sealing all joints between cone, adjusting rings, and manhole frame.
2. When grade rings or bricks are used, grout with non-shrink grout.
3. Install radially laid concrete brick with 1/4-inch-thick, vertical joints at inside perimeter.
4. Lay concrete brick in full bed of mortar and completely fill joints.
5. If more than one course of concrete brick is required, stagger vertical joints.
6. Manhole frames which are placed above final grade will have frames attached to manhole cone section by means of 5/8-inch diameter stainless steel anchors and washers. One anchor bolt shall be provided per hole.
7. Seal pipe penetrations, including pipe crown, to provide a smooth, uniform finish using non-shrink grout.
8. When flat slab tops are utilized, frames shall be cast into the top for access into manholes.

3.04. FIELD QUALITY CONTROL

A. Testing:

1. Cast-in-Place Concrete: As specified.
2. Concrete Manhole Sections: As specified.

- B. After the placement of manhole frame and vacuum testing, perform the final finishing to the manhole interior by filling all chips or fractures greater than 1/2-inch in length, width, or depth (1/8-inch-deep in inverts) with non-shrink grout. Grout the interior joints between the precast concrete sections with non-shrink grout. Sharp edges or rough finishes shall be removed providing a smooth surface throughout the manhole. Clean the interior of the manhole, removing all dirt, spills, or other foreign matter.

- C. Equipment Acceptance: Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

3.05. ADJUSTING

A. Vertical Adjustment of Manholes and Structures:

1. After the manhole has been set in its final position, set the manhole frames to the required elevation using no more than 12 inches of precast concrete grade rings, or bricks sealing all joints between cone, adjusting rings, and manhole frame. When grade rings or bricks are used, grout with non-shrink grout.
2. Where manholes are constructed in paved areas, the top surface of the frame and cover shall be tilted so as to conform to the exact slope, crown and grade of the existing surrounding pavement.
3. Manholes installed outside roadway areas, but in other landscaped or maintained areas shall be set flush with the surround grade, unless otherwise indicated.
4. Manholes installed in areas not regularly maintained shall be set approximately 24-inches above the surrounding grade.

END OF SECTION 330561



## SECTION 330563 - CONCRETE VAULTS AND CHAMBERS

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary for the installation of concrete vaults and chambers in accordance with the plans. All materials, testing, and procedures shall be of the type specified herein.

##### B. Section Includes:

1. Precast concrete vaults and chambers.
2. Drainage system junction boxes.
3. Drainage system sedimentation chambers.
4. Knock-out boxes.
5. End walls.
6. Pipe ends.
7. Frames and covers.
8. Access hatches.

#### 1.02. REFERENCE STANDARDS

##### A. American Association of State Highway and Transportation Officials:

1. AASHTO HB-17 - Standard Specifications for Highway Bridges.

##### B. American Concrete Institute:

1. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
2. ACI 305R - Guide to Hot Weather Concreting
3. ACI 306R - Guide to Cold Weather Concreting
4. ACI 318 - Building Code Requirements for Structural Concrete.

##### C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.
2. AWS D1.4 - Structural Welding Code - Reinforced Steel.

##### D. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A48 - Standard Specification for Gray Iron Castings
3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

4. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
5. ASTM A706 -Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
6. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
7. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars
8. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
9. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
10. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
11. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field
12. ASTM C33 - Standard Specification for Concrete Aggregates
13. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
14. ASTM C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
15. ASTM C70 - Standard Test Method for Surface Moisture in Fine Aggregate
16. ASTM C88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
17. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
18. ASTM C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
19. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete
20. ASTM C150 - Standard Specification for Portland Cement
21. ASTM C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
22. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
23. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete
24. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
25. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

26. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
27. ASTM C566 - Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
28. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
29. ASTM C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
30. ASTM C877 - Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections.
31. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
32. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
33. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
34. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
35. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
36. ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars
37. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
38. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
39. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
40. ASTM C1227 - Standard Specification for Precast Concrete Septic Tanks
41. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures
42. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
43. ASTM C1433 - Standard Specification for Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.
44. ASTM C1478 - Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes, and Laterals
45. ASTM C1504 - Standard Specification for Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts and Storm Drains.
46. ASTM C1582 - Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete
47. ASTM C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

- 48. ASTM C1611 - Standard Test Method for Slump Flow of Self-Consolidating Concrete
- 49. ASTM C1719 - Standard Test Method for Installed Precast Concrete Tanks and Accessories by the Negative Air Pressure (Vacuum) Test Prior to Backfill
- 50. ASTM D558 - Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures

E. National Precast Concrete Association:

- 1. NPCA Plant Certification Program.
- 2. NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.

F. North Carolina Department of Transportation

- 1. Standard Specifications for Roads and Structures, latest revision

G. The Society for Protective Coatings:

- 1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.03. SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit manufacturer information for frames and covers, sealants, gaskets, pipe entry connectors, steps, racks, anchors, lifting inserts, and other devices.

C. Shop Drawings:

- 1. Furnish the drawings from the precast concrete producer for precast concrete units.
- 2. Indicate vault or chamber locations, elevations, sections, equipment supports, piping, conduit, sizes, and dimensions of all penetrations, and special embed items.
- 3. Indicate design loads, construction and installation details, typical reinforcement size and placement and additional reinforcement at openings for each custom type, size, and configuration.

D. Upon request, submit concrete mix design for each strength and type of concrete that will be used. Include the quantity, type, brand, and applicable data sheets for all design constituents as well as documentation indicating conformance with applicable reference specifications.

E. Manufacturer's Certificate: The precast concrete producer shall supply submittals that certify that products meet or exceed specified requirements.

1. At a minimum, the following shall be shown on the submittals:

- a. Live load used in design
- b. Vertical and lateral earth loads used in design
- c. Depth of soil fill on the structure
- d. Water table depth used in calculations

2. The precast concrete producer shall ensure that the structure will not float when subjected to buoyant forces during the construction stage as well as after the structure

has been installed and completely backfilled. Submit the calculations used to determine the necessity of any anti-flotation method used.

- F. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
  - G. Source Quality-Control Submittals: Upon request, indicate results of factory tests and inspections.
    - 1. This may include mill tests and all other test data for Portland cement, blended cement, pozzolans, ground granulated blast-furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.
    - 2. Submit copies of test reports showing that the design mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, plastic air content, temperature of freshly mixed concrete, and slump of freshly mixed concrete.
    - 3. Copies of the precast concrete producer's in-plant QA/QC inspection reports.
  - H. Qualifications Statements:
    - 1. Submit qualifications for manufacturer, installer, and licensed professional.
    - 2. Submit manufacturer's approval of installer.
- 1.04. QUALITY ASSURANCE
- A. Obtain precast concrete vaults and chambers from single source.
  - B. Perform structural design according to ACI 318. Design must also consider stresses induced during handling, shipping, and installation in order to avoid product cracking or other handling damage.
  - C. Perform Work according to NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.
  - D. Material and Fabrication:
    - 1. Single-Cell Box Culverts: Comply with ASTM C1433.
    - 2. Three-Sided Structures: Comply with ASTM C1504.
    - 3. Other Structures: Comply with ASTM C913.
  - E. Welding:
    - 1. Structural Steel: Comply with AWS D1.1.
    - 2. Reinforcing Steel: Comply with AWS D1.4.
  - F. Where applicable, perform Work according to State of North Carolina Department of Transportation standards and the more stringent methods specified herein.
- 1.05. QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.
    - 1. The precast producer shall maintain a permanent quality control department.

2. The precast concrete producer shall have a quality control program which is audited for compliance annually by persons outside that plant's employee structure.
  3. Upon request, the precast concrete producer shall supply a copy of their quality control manual.
  - B. Any plant producing precast concrete units for this specification shall have a written, implemented, comprehensive safety and environmental program. Upon request, documentation shall be provided to show the safety program meets the following minimum requirements.
    1. The safety program shall include the following written and documented parts as a minimum:
      - a. Housekeeping
      - b. Lock-Out Tag-Out
      - c. Machine Guarding
      - d. Risk Assessment
      - e. Personal Protective Equipment
      - f. CONTRACTOR and Visitor Safety
      - g. Cranes and Lifting Equipment Safety
      - h. Ergonomics and Handling Safety
      - i. Fall Protection
    2. Health and Safety Management System Requirements
      - a. The health and safety management system shall be used to manage the safety program and all measurable aspects.
    3. The Environmental Management System shall encompass the following:
      - a. Air Pollution Control
      - b. Water and Wastewater Management
    4. Recordable rate
      - a. The recordable rate shall be below the industry average. If the industry average is not readily available, assume a value of six recordable injuries per 200,000 hours worked as the industry average.
  - C. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience.
  - D. Welders: AWS qualified within previous 12 months for employed weld types.
  - E. Licensed Professional: Professional ENGINEER experienced in design of specified Work and licensed in State of North Carolina.
- 1.06. DELIVERY, STORAGE, AND HANDLING
- A. Section 01 55 00 - Site Access and Storage.

- B. Concrete Products: Do not deliver products until concrete has cured five days or has attained minimum 70 percent of specified 28-day compressive strength.
  - C. Inspection: Accept materials on Site in manufacturer's original packaging. All precast concrete units shall be inspected by the OWNER for quality and final acceptance.
  - D. Handling:
    - 1. Comply with manufacturer instructions for unloading, storing, and moving vaults or chambers.
    - 2. Lift vaults or chambers from designated lifting points as indicated on the shop drawings.
    - 3. Lifting devices or holes shall be consistent with industry standards.
    - 4. Upon request, the precast concrete producer shall provide documentation on acceptable handling methods for the product.
  - E. Storage:
    - 1. Store materials according to manufacturer instructions in a manner that will minimize potential damage.
    - 2. Store vaults and chambers to prevent damage to OWNER's property or other public or private property.
    - 3. Repair property damaged from materials storage.
  - F. Protection:
    - 1. Protect materials in clean location remote from construction operations areas.
    - 2. Provide additional protection according to manufacturer instructions.
- 1.07. EXISTING CONDITIONS
- A. Field Measurements:
    - 1. Verify field measurements prior to fabrication.
    - 2. Indicate field measurements on Shop Drawings.
  - B. All underground facilities and structures such as gas, water, sewer, power, telephone cable, and so forth shall be located and identified. Location markings shall be placed by the affected utilities before construction.
  - C. Identify obstacles such as overhead wires, building structures that will interfere with crane operations, work progress, or create a safety hazard.
- 1.08. WARRANTY
- A. Section 01 74 00 - Warranties and Bonds.
  - B. Furnish five-year manufacturer's warranty for concrete vaults, chambers, and appurtenances.

## PART 2 PRODUCTS

### 2.01. PERFORMANCE AND DESIGN CRITERIA

- A. Minimum Loading: Comply with ASTM C857 and ASTM C890.
  - B. Roof Live Load, with Impact Loading:
    - 1. Heavy Traffic:
      - a. Comply with AASHTO HB-17; HS20-44.
      - b. Maximum Each Wheel: 16,000 lbf.
    - 2. Medium Traffic:
      - a. Comply with AASHTO HB-17; HS15-44.
      - b. Maximum Each Wheel: 12,000 lbf.
    - 3. Light Traffic:
      - a. Comply with AASHTO HB-17; HS10.
      - b. Maximum Each Wheel: 8,000 lbf.
    - 4. Walkway Traffic:
      - a. Comply with ASTM C857; A-0.3.
      - b. Maximum Loading: 300 psf.
  - C. Box Culvert Roof Live Load:
    - 1. Comply with AASHTO HB-17; HS20.
    - 2. Interstate live loads and impact loads.
- 2.02. PRECAST CONCRETE VAULTS AND CHAMBERS
- A. Material of Construction: Reinforced precast concrete.
  - B. Foundation Slab:
    - 1. Cast-in-place concrete of type as specified.
    - 2. Top Surface: Leveled.
- 2.03. FRAMES AND COVERS
- A. Description:
    - 1. Materials of Construction:
      - a. Cast iron.
      - b. Comply with ASTM A48; minimum Class 30.
    - 2. Lid:
      - a. Size: As indicated on Drawings.
      - b. Surface: Machined flat bearing.
      - c. Type: Removable.
      - d. Security: Lockable.
    - 3. Cover:



- a. Design: Closed.
- b. Fabrication: Molded.
- c. Identification: Cast with municipality name and logo.
- 4. Furnish sealing gasket as indicated.
- 5. Grate:
  - a. Configuration: Diagonal.
  - b. Size: As indicated on Drawings.

#### 2.04. ACCESS HATCHES

##### A. Description:

- 1. Materials of Construction: Aluminum; welded.
- 2. Size: As indicated on Drawings.
- 3. Door Configuration: Single or Double as shown on the construction drawings.
- 4. Cover:
  - a. Fabrication: Diamond plate.
  - b. Reinforce with structural stiffeners as required to support indicated loads.
- 5. Frame:
  - a. Type: Angle.
  - b. Furnish integral seat to support cover stiffeners.
  - c. Anchor flange around frame perimeter.
- 6. Hinge Material: Stainless steel.
- 7. Lift Handle:
  - a. Type: Flush drop; non-removable.
  - b. Mounting: In cover.
- 8. Lifting Mechanism:
  - a. Compression Springs: Stainless steel.
  - b. Furnish automatic hold-open and dead stop to retain cover in open position.
  - c. Cover springs to prevent contact by personnel entering vault or chamber.
- 9. Latch Mechanism:
  - a. Lock: Stainless steel.
  - b. Furnish padlock hasp.
- 10. Hardware: Stainless steel.
- 11. Finishes: Unfinished.

#### 2.05. MATERIALS

- A. Concrete:
    - 1. Portland Cement:
      - a. Comply with ASTM C150.
      - b. Type: I – Normal, II – Moderate, III - High Early Strength, or V - Sulfate Resistant.
    - 2. Fine and Coarse Aggregates: Comply with ASTM C33, except that gradation requirements do not apply.
    - 3. Water: Comply with ASTM C1602. Clean and not detrimental to concrete.
    - 4. Silica Fume: Comply with ASTM C1240.
  - B. Admixtures:
    - 1. Air Entrainment: Comply with ASTM C260.
    - 2. Chemical Admixtures: Comply with ASTM C494.
    - 3. Fly Ash and Calcined Pozzolan: Comply with ASTM C618.
    - 4. Blast Furnace Slag: Comply with ASTM C989, Grade 100 or 120.
    - 5. Corrosion inhibitors: Comply with ASTM C1582.
    - 6. Pigments:
      - a. Description: Mineral oxide; nonfading; lime resistant.
      - b. Color: as selected.
  - C. Concrete Reinforcement:
    - 1. Reinforcing Steel: Comply with ASTM A615 or ASTM A706.
    - 2. Reinforcing Wire: Comply with ASTM A1064.
    - 3. Welded Steel Wire Fabric: Comply with ASTM A1064.
- 2.06. FABRICATION
- A. Comply with ACI 318 and NPCA Quality Control Manual for Precast and Prestressed Concrete Plants.
  - B. Fabricate vaults, chambers, knock-out panels, and openings to size and configuration as indicated on Drawings.
  - C. Forms:
    - 1. Forms shall be of the type and design consistent with industry standards and practices. Construct forms so that the forces and vibrations to which the forms will be subjected cause no damage to the precast concrete unit.
    - 2. Fabricate to provide uniform precast concrete units with consistent dimensions.
    - 3. Form release agents shall be applied according to the manufacturer's recommendations.
    - 4. Clean after each use.
  - D. Reinforcing:

1. Install reinforcement by tying or welding to make rigid assemblies.
2. Secure reinforcement to prevent displacement while placing concrete.
- E. Position and secure embedded items at locations specified in the design documents to prevent displacement while placing concrete.
- F. Preplacement Check:
  1. All products shall be inspected for accuracy prior to placing concrete. Checks shall include, but not be limited to, form condition and cleanliness, form dimensions, joints, release agent, block outs, inserts and locations, lifting devices, reinforcing steel size, spacing, clearances, and proper placement.
  2. Preplacement checks shall be performed by manufacturer and documented. A drawing with verifications of the above criteria can be used as documentation.
- G. Deposit concrete in forms and consolidate concrete without segregating aggregate. Keep the freefall of concrete to a minimum.
- H. Cold Weather Concreting: Comply with ACI 306R.
  1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing temperatures. All concrete materials, reinforcement, and forms shall be free from frost. The temperature of the concrete at the time of placement shall not be below 45° F. Discard concrete that freezes before it reaches a compressive strength of 500 psi.
- I. Hot Weather Concreting: Comply with ACI 305R.
  1. Minimize excessive concrete temperatures and water evaporation. The temperature of concrete at the time of placing shall not exceed 95° F.
- J. Provide initial curing by retaining moisture using one of following methods:
  1. Cover with PE sheets.
  2. Cover with burlap or other absorptive material and keep continually moist.
  3. Apply curing compound according to manufacturer instructions.
- K. Provide final curing according to manufacturer's standard.
- L. The surface finish shall be as specified on the contract documents and/or approved shop drawings.
- M. Do not remove precast concrete units from the forms until the concrete reaches the compressive strength for stripping required by design. Measure stripping strengths routinely to ensure product has attained sufficient strength for safe handling.
- N. Remove forms without damaging concrete. Defects that will not impair the functional use or expected life of the precast concrete unit may be repaired by any method that does not impair the product

## 2.07. MIXES

- A. Concrete:
  1. For non-machine cast products, the concrete shall be self-consolidating concrete which produces minimal bug holes and does not segregate.

2. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.
3. Batching weight and volume measurement devices shall be annually calibrated by an independent testing laboratory or more frequently if batching irregularities or concrete inconsistencies are observed.
4. Selection of proportions for concrete shall be based on current self-consolidating concrete mix design techniques. At a minimum, ACI 211.1 and 318 shall be used.
5. Concrete Criteria:
  - a. Compressive Strength: 5,000 psi at 28 days.
  - b. Water-Cement Ratio:
    - 1) Concrete Exposed to Freezing and Thawing: Maximum 0.45 percent by mass.
    - 2) Watertight Concrete Not Exposed to Freezing and Thawing but required to be leak resistant: Maximum 0.48 percent by mass.
    - 3) Concrete Exposed to Corrosive Conditions: Maximum 0.40 percent by mass.
  - c. Air Content:
    - 1) Maximum Aggregate Size of 3/8 Inch:
      - a) Severe Exposure: 6.0 to 9.0 percent.
      - b) Moderate Exposure: 4.5 to 7.5 percent.
    - 2) Maximum Aggregate Size of 1/2 Inch:
      - a) Severe Exposure: 5.5 to 8.5 percent.
      - b) Moderate Exposure: 4.7 to 7.0 percent.
    - 3) Maximum Aggregate Size of 3/4 Inch:
      - a) Severe Exposure: 4.5 to 7.5 percent.
      - b) Moderate Exposure: 3.5 to 6.5 percent.
    - 4) Maximum Aggregate Size of 1 Inch:
      - a) Severe Exposure: 4.5 to 7.5 percent.
      - b) Moderate Exposure: 3.0 to 6.0 percent.
    - 5) Maximum Aggregate Size of 1½ Inches:
      - a) Severe Exposure: 4.5 to 7.0 percent.
      - b) Moderate Exposure: 3.0 to 6.0 percent.
    - 6) For specified compressive strengths greater than 5,000 psi, air content may be reduced 1%
6. Admixtures:
  - a. Include admixture types and quantities indicated in concrete mix designs approved through submittal process.

- b. Do not use calcium chloride.

2.08. FINISHES

A. Reinforcing Steel:

- 1. Galvanized Finish (where required): Comply with ASTM A767, Class I.
- 2. Epoxy-Coated Finish (where required): Comply with ASTM A775.

B. Wire and Wire Fabric:

- 1. Epoxy-Coated Finish (where required): Comply with ASTM A884, Class A.

C. Concrete:

- 1. Formed Surfaces Not Exposed to View: As formed.
- 2. Unformed Surfaces:
  - a. Finish with vibrating screed or hand float.
  - b. Items Permitted: Color variations, minor indentations, chips, and spalls.
  - c. Items Not Permitted: Major imperfections, honeycomb, or other such defects.

D. Steel:

- 1. Galvanizing:
  - a. Comply with ASTM A123.
  - b. Hot dip galvanize after fabrication.

2.09. ACCESSORIES

A. Membrane Curing Compound: Comply with ASTM C309, Type I or I-D, Class A or B.

B. Step Rungs:

- 1. Material: Formed steel-reinforced polypropylene.
- 2. Diameter: ½-inch.
- 3. Width: Minimum 12 inches.
- 4. Spacing: 12 to 16 inches o.c. vertically.

C. Inserted and Embedded Items:

- 1. Structural-Steel Sections:
  - a. Comply with ASTM A36.
  - b. Finish: Galvanized

D. Joint Sealants and Joint Gaskets: As indicated on Shop Drawings.

- 1. Gasket Joints for Circular Concrete Pipe:
  - a. Comply with ASTM C443.
  - b. Gaskets: Standard rubber.
- 2. External Sealing Bands:

- a. Comply with ASTM C877.
    - b. Material: Type II, plastic film, mesh reinforced.
  - 3. Preformed Joint Sealants for Concrete Pipe and Box Sections: Comply with ASTM C990.
  - 4. Elastomeric Joint Sealants:
    - a. Comply with ASTM C920.
    - b. Grade NS, Class 25.
  - E. Pipe Entry Connectors: Comply with ASTM C923 or ASTM C1478.
  - F. Grout:
    - 1. Cement Type: Portland cement, sand, and water mixture with stiff consistency to suit intended purpose.
    - 2. Nonshrink Type:
      - a. Description: Premixed compound consisting of nonmetallic aggregate, cement, and water-reducing and plasticizing agents.
      - b. Comply with ASTM C1107.
  - G. Touch-Up Primer for Galvanized Surfaces:
    - 1. SSPC Paint 20, Type II Organic.
    - 2. Comply with ASTM A780.
- 2.10. SOURCE QUALITY CONTROL
  - A. Testing:
    - 1. The precast concrete producer may be required to show that the following quality control tests are performed as required:
      - a. Slump: Comply with ASTM C143 or ASTM C1611 as applicable.
      - b. Compressive Strength: ASTM C31, ASTM C192, and ASTM C39.
      - c. Air Content: Comply with ASTM C231.
      - d. Unit Weight: Comply with ASTM C138.
      - e. Temperature: Comply with ASTM C1064.
    - 2. Make test results available to ENGINEER upon request.
  - B. Inspection:
    - 1. Visually inspect completed vaults and chambers for defects.
    - 2. Repair defects on surfaces exposed to view to achieve uniform appearance.
    - 3. Repair honeycomb by removing loose material, cutting back the honeycombed areas into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged, and applying a cement-sand grout or an approved bonding agent followed immediately by consolidating an

appropriate repair material into the cavity to produce smooth surface flush with adjacent surface.

4. Repair major defects only if permitted by OWNER.

C. OWNER Inspection:

1. Make units covered by this specification available for inspection at manufacturer's factory prior to packaging for shipment.
2. Notify OWNER at least three days before inspection is allowed.

D. OWNER Witnessing:

1. Allow witnessing of factory inspections and tests at manufacturer's test facility.
2. Notify OWNER at least seven days before inspections and tests are scheduled.

E. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

- A. Verify that items provided by other Sections of Work are properly sized and located.
- B. Verify correct size and elevation of excavation.
- C. Verify that subgrade is properly prepared, compacted to 95% of ASTM D558 density, and ready to receive Work of this Section.
  1. The subgrade shall be a minimum of 6 inches in depth.
  2. Use a granular material to create a level surface for placing the precast concrete unit.

#### 3.02. PREPARATION

- A. Provide adequate access to the site to facilitate hauling, storage, and proper handling of the precast concrete units.
- B. Secure permits required to do work in accordance with the detail plans before starting the job. Retain all permits or a record of the permits on the Site for immediate reference.
- C. Should it appear that a structure location will interfere with traffic, review the situation with the ENGINEER, and notify appropriate authorities.
- D. Provide for access to call boxes, fire hydrants, etc.
- E. Mark each vault or chamber by indentation or using waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Drawings to indicate its intended use.
- F. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.

- G. Do not install vault or chamber if Site conditions induce loads exceeding weight capacity of vault or chamber.
  - H. Inspect vaults and chambers immediately prior to placement in excavation to verify that they are internally clean and free from damage; remove and replace damaged units.
- 3.03. INSTALLATION
- A. According to ASTM C891.
  - B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface structures or utilities in immediate or adjacent areas. If any damage occurs, notify the OWNER of the damaged facility immediately.
  - C. While lowering vaults or chambers into excavations and joining pipe to units, take precautions to ensure that interiors of pipeline and structure remain clean.
  - D. Lift precast concrete units by suitable lifting devices at points provided by the precast concrete producer.
  - E. Install vaults and chambers to elevation and alignment as indicated on Drawings.
  - F. Install cast-in-place concrete foundation slab as specified and install and anchor structure to base slab.
  - G. Excavating:
    - 1. As specified and in indicated locations and depths.
    - 2. Provide clearance around sidewalls of manhole or structure for construction operations.
    - 3. If ground water is encountered, prevent accumulation of water in excavations, place structure in dry trench. Also verify that the design accounts for the level of groundwater encountered.
    - 4. Inspect excavations after every rainstorm or other hazard-increasing occurrence, and increase the protection against slides and cave-ins, if necessary
    - 5. If unforeseen facilities or obstructions are encountered, stop excavation operations immediately. Expose the obstructions and investigate them with caution. If there is any doubt as to the type of obstruction exposed, request positive identification from the OWNER of the facility and then proceed as circumstances dictate.
    - 6. Remove large stones or other hard matter impeding consistent backfilling or compaction.
    - 7. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor manhole or structure to avoid flotation as approved by ENGINEER.
    - 8. Correct over-excavation with coarse aggregate.
  - H. Base and Alignment (slabs):
    - 1. Place foundation slab and trowel top surface level.
    - 2. Grout base of shaft to achieve slope to drain, trowel smooth, and contoured as indicated on Drawings.



3. Place sections plumb and level, trim to correct elevations, and anchor to foundation slab.

I. Base and Alignment (vaults and chambers):

1. Install vaults and chambers supported at proper grade and alignment on compacted crushed-stone bedding.
2. Grout base of shaft to achieve slope to drain, trowel smooth, and contoured as indicated on Drawings.

J. Assembly of Multi Section Structures:

1. Lower each section into excavation.
2. Clean joint surfaces.
3. Install watertight joint seals according to manufacturer instructions using gasket joints, external sealing bands, preformed joint sealants, elastomeric joint sealants, and grout.

K. Knock-out Boxes:

1. Remove knock outs or cut structure to receive piping without creating openings larger than required to fit pipe.
2. Fill annular space with grout.

L. Connections:

1. Connect pipe to structure and seal watertight.
2. Cut pipe flush with interior of structure.

M. Frame and Cover and/or Access Hatch:

1. Set level, without tipping, to elevations as indicated on Drawings.
2. Set frame and cover and/or access hatch minimum 2 inches above finished grade for structures located within unpaved areas, unless otherwise shown on Plans.

N. Backfill excavations for vaults and chambers as specified as soon as possible after the structure has been placed.

1. Backfilling shall be achieved by lifts (layers) to the required compaction.
2. Follow up inspections for settlements are required. Should settlement occur, the CONTRACTOR shall be responsible for all necessary repairs.

3.04. FIELD QUALITY CONTROL

A. Verify and document final field elevations and compaction properties.

B. Testing:

1. Vacuum Test: As specified. Comply with ASTM C1719 or ASTM C1227 as applicable if required by ENGINEER.

END OF SECTION



SECTION 331413 - PUBLIC WATER UTILITY DISTRIBUTION PIPING

- 1.1 Refer to Appendix A, Section 3.0 - Design Considerations for Water System Extensions and Section 10.0 - Material Specifications for Water System Extensions (Town of Beaufort Standard Specifications).

END OF SECTION 331413



SECTION 331417 - SITE WATER SERVICE UTILITY LATERALS

- 1.1 Refer to Appendix A, Section 3.0 - Design Considerations for Water System Extensions and Section 10.0 - Material Specifications for Water System Extensions (Town of Beaufort Standard Specifications).

END OF SECTION 331417



SECTION 331419 - VALVES AND HYDRANTS FOR WATER UTILITY SERVICE

- 1.1 Refer to Appendix A, Section 3.0 - Design Considerations for Water System Extensions and Section 10.0 - Material Specifications for Water System Extensions (Town of Beaufort Standard Specifications).

END OF SECTION 331419





## SECTION 332760 - UNDERGROUND UTILITY DETECTION SYSTEM

### PART 1 GENERAL

#### 1.01. SCOPE OF WORK

- A. The work covered by this section consists of all work necessary to furnish and install the pipeline tracer wire system used to locate buried underground pipelines.
- B. All materials used on this project must have a preliminary inspection by the Inspector before being used for construction purposes. Rejection of materials not meeting specifications shall be immediately removed from the job site.

#### 1.02. SUBMITTALS

- A. The CONTRACTOR shall submit to the ENGINEER shop drawings for all products and components provided under this specification section to be used for the construction of this project.

### PART 2 PRODUCTS

#### 2.01. COLOR CODING

- A. All trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.

#### 2.02. TRACE WIRE

##### A. Open Trench

- 1. Trace wire shall be #14 AWG Copper Clad Steel with a minimum 250 lb. break load and a minimum 30 mil HDPE insulation thickness.

##### B. Directional Drilling/Boring

- 1. Trace wire shall be #12 AWG Copper Clad Steel with a minimum 1,150 lb. break load and a minimum 45 mil HDPE insulation thickness.

##### C. Pipe Bursting/Slip Lining

- 1. Trace wire shall be 7x19 stranded 304 Stainless Steel with a minimum 3,700 lb. break load and a with a minimum 45 ml HDPE insulation thickness.

#### 2.03. CONNECTORS

- A. All mainline trace wires must be interconnected in intersections, mainline tees, and mainline crosses. At tees, the three wires shall be joined using a single 3-way lockable connector. At crosses, the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
- B. Direct bury wire connectors shall include 3-way lockable connectors and mainline to lateral lug connectors specifically manufactured for use in underground trace wire installation. Connectors shall be dielectric silicon filled to seal out moisture and corrosion and shall be installed in a manner so as to prevent any uninsulated wire exposure.
- C. Non-locking friction fit, twist on or taped connectors are prohibited.

#### 2.04. ACCEPTABLE PRODUCTS

- A. The following products have been deemed acceptable and appropriate. These products are a guide only to help you choose the correct applications for your tracer wire project.
1. Copper clad Steel (CCS) trace wire
    - a. Open Trench
      - 1) Copperhead part # 1430-HS
    - b. Directional Drilling/Boring
      - 1) Copperhead part # 1245\*EHS
    - c. Pipe Bursting/Slip Lining
      - 1) Copperhead part # PBX-50
  2. Connectors
    - a. Copperhead 3-way locking connector part # LSC1230\*
    - b. DryConn 3- way Direct Bury Lug: Copperhead Part # 3WB-01
  3. Termination/Access
    - a. Non-Roadway access boxes applications
      - 1) Trace wire access boxes Grade level Copperhead adjustable lite duty Part # LD14\*TP
    - b. Concrete / Driveway access box applications
      - 1) Trace wire access boxes Grade level Copperhead Part # CD14\*TP 14"
    - c. Fire hydrant trace wire access box applications
      - 1) Above ground two terminal with 1-inch conduit. Copperhead part # T3-75-F (Cobra T3 Test Station, denoting "F" includes mounting flange)
  4. Grounding
    - a. Drive in Magnesium Anode
      - 1) Copperhead Part # ANO-1005 (1.5 lb)

### PART 3 INSTALLATION

#### 3.01. GENERAL

- A. Trace wire installation shall be performed in such a manner that allows proper access for connection of line tracing equipment, proper locating of wire without loss or deterioration of low frequency (512Hz) signal for distances in excess of 1,000 linear feet, and without distortion of signal caused by multiple wires being installed in close proximity to one another.
- B. Trace wire systems must be installed as a single continuous wire, except when using approved connectors. No looping or coiling of wire is allowed.
- C. Any damage occurring during installation of the trace wire must be immediately repaired by removing the damaged wire and installing a new section of wire with approved connectors. Taping and/or spray coating shall not be allowed.

- D. Trace wire shall be installed at the bottom half of the pipe and secured (taped/tied) at 5' intervals.
- E. Trace wire must be properly grounded as specified.
- F. Trace wire on all service laterals/stubs must terminate at an approved trace wire access box located directly above the utility, at the edge of the road right-of-way, but out of the roadway. (See Trace Wire Termination/Access)
- G. At all mainline dead-ends, trace wire shall go to ground using an approved connection to a drive-in magnesium grounding anode rod, buried at the same depth as the trace wire. (See Grounding)
- H. Mainline trace wire shall not be connected to existing conductive pipes. Treat as a mainline dead- end, ground using an approved waterproof connection to a grounding anode buried at the same depth as the trace wire.
- I. All service lateral trace wires shall be a single wire, connected to the mainline trace wire using a mainline to lateral lug connector, installed without cutting/splicing the mainline trace wire.
- J. In occurrences where an existing trace wire is encountered on an existing utility that is being extended or tied into, the new trace wire and existing trace wire shall be connected using approved splice connectors and shall be properly grounded at the splice location as specified.

### 3.02. TERMINATION/ACCESS

- A. All trace wire termination points must utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.
- B. All grade level/in-ground access boxes shall be appropriately identified with "sewer" or "water" cast into the cap and be color coded.
- C. A minimum of 2 feet of excess/slack wire is required in all trace wire access boxes after meeting final elevation.
- D. All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
- E. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.

### 3.03. SERVICE LATERALS ON PUBLIC PROPERTY

- A. Trace wire must terminate at an approved grade level/in- ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway.

### 3.04. SERVICE LATERALS ON PRIVATE PROPERTY

- A. Trace wire must terminate at an approved above-ground trace wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than 5 vertical feet above finished grade, or terminate at an approved grade level/in-ground trace wire access box, located within 2 linear feet of the building being served by the utility.

3.05. HYDRANTS

- A. Trace wire must terminate at an approved above-ground trace wire access box, properly affixed to the hydrant grade flange. Affixing with tape or plastic ties shall not be acceptable.

3.06. LONG-RUNS, IN EXCESS OF 500 LINEAR FEET WITHOUT SERVICE LATERALS OR HYDRANTS

- A. Trace wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a minimum 48" polyethylene marker post, color coded per APWA standard for the specific utility being marked.

3.07. GROUNDING

- A. Trace wire must be properly grounded at all dead ends/stubs.
- B. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20 feet of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically manufactured for this purpose and buried at the same elevation as the utility.
- C. When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.
- D. When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.
- E. Where the anode wire will be connected to a trace wire access box, a minimum of 2 feet of excess/slack wire is required after meeting final elevation.

3.08. SANITARY SEWER SYSTEM

- A. A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.
- B. Lay mainline trace wire continuously, by-passing around the outside of manholes/structures on the North or East side.
- C. Trace wire on all sanitary service laterals must terminate at an approved trace wire access box color coded green and located directly above the service lateral at the edge of road right of way.

3.09. WATER SYSTEM

- A. A mainline trace wire must be installed, with all service lateral trace wires properly connected to the mainline trace wire, to ensure full tracing/locating capabilities from a single connection point.

- B. Lay mainline trace wire continuously, by-passing around the outside of valves and fittings on the North or East side.
- C. Trace wire on all water service laterals must terminate at an approved trace wire access box color coded blue and located directly above the service lateral at the edge of road right of way.
- D. Above-ground tracer wire access boxes will be installed on all fire hydrants.
- E. All conductive and non-conductive service lines shall include tracer wire.

3.10. PROHIBITED PRODUCTS AND METHODS

- A. The following products and methods shall not be allowed.
  - 1. Uninsulated trace wire
  - 2. Trace wire insulations other than HDPE
  - 3. Trace wires not domestically manufactured
  - 4. Non-locking, friction fit, twist on or taped connectors
  - 5. Brass or copper ground rods
  - 6. Wire connections utilizing taping or spray-on waterproofing
  - 7. Looped wire or continuous wire installations that have multiple wires installed side-by-side or in close proximity to one another
  - 8. Trace wire wrapped around the corresponding utility
  - 9. Brass fittings with trace wire connection lugs
  - 10. Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
  - 11. Connecting trace wire to existing conductive utilities

3.11. TESTING

- A. All new trace wire installations shall be located using typical low frequency (512Hz) line tracing equipment, witnessed by the contractor, engineer and facility owner as applicable, prior to acceptance of ownership.
- B. This verification shall be performed upon completion of rough grading and again prior to final acceptance of the project.
- C. Continuity testing in lieu of actual line tracing shall not be accepted.

END OF SECTION 332760



## SECTION 333111 - SANITARY SEWERAGE GRAVITY PIPING

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to install and complete installation of sanitary sewer gravity piping and appurtenances in accordance with the plans. All pipe and appurtenance material shall be of the type and class specified herein.

##### B. Section Includes:

1. Sanitary sewerage piping.
2. Connection to existing manholes.
3. Wye branches.
4. Sanitary laterals.
5. Pile support systems.
6. Bedding and cover materials.

#### 1.02. REFERENCE STANDARDS

##### A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a (10-lb) Rammer and a 457-mm (18-in.) Drop.

##### B. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
6. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.

##### C. ASTM International:

1. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
2. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe
3. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures
4. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.

5. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
6. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
7. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
8. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
9. ASTM F1668 - Standard Guide for Construction Procedures for Buried Plastic Pipe

D. North Carolina Administrative Code

1. 15A NCAC 02T - Waste Not Discharged to Surface Waters

E. National Fire Protection Association

1. NFPA 70 - National Electrical Code

1.03. COORDINATION

- A. Coordinate Work of this Section with appropriate utilities department.
- B. Do not interrupt service to facilities occupied by OWNER or others unless approved by the ENGINEER and OWNER no fewer than 72 hours in advance of proposed interruption and after arranging to provide temporary sewer service.

1.04. SUBMITTALS

- A. Section 01 30 00 - Electronic Submittals.
- B. Product Data: Submit manufacturer information indicating proposed materials, accessories, details, and construction information.
- C. Installation manuals shall be furnished to the ENGINEER for his review and approval prior to installation of any materials. The ENGINEER may augment any manufacturer's installation recommendations if, in his opinion, it will best serve the interest of the OWNER.
- D. Shop Drawings:
  1. Drawings and descriptive data on manholes (including wall thicknesses, vertical dimensions, and deflection angles), concrete used in manufacture of manholes and precast inverts, rubber gaskets, joint sealant, flexible manhole sleeves and joints, frames and covers, inverts, and manhole steps shall be submitted to the ENGINEER for review prior to their manufacture.
  2. All sizes and types of pipe.
  3. All pipe fittings and appurtenances.
  4. All transition couplings.
- E. Field Quality-Control Submittals: Indicate results of CONTRACTOR-furnished tests and inspections.



- F. Preconstruction Photographs and/or Video: Submit digital files of photographs and/or video of Work areas and material storage areas, as specified in Section 01 39 00 – Pre-Construction Video
- 1.05. CLOSEOUT SUBMITTALS
  - A. Section 01 72 00 - Project Record Documents.
  - B. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, material changes, manholes service lines, and cleanouts.
  - C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
- 1.06. QUALITY ASSURANCE
  - A. Perform Work according to 15A NCAC 02T and the following requirements:
    - 1. Comply with all requirements of utility OWNER.
    - 2. Comply with all standards of authorities having jurisdiction for public sanitary sewerage, including materials, installation, and testing.
  - B. All piping materials shall bear label, stamp, or other markings of specified testing agency.
- 1.07. QUALIFICATIONS
  - A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience. Upon request of the ENGINEER, Manufacturer shall provide documentation of experience.
  - B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience in installation of necessary materials. Upon request of the ENGINEER, Installer shall provide documentation of experience.
  - C. The design, installation, and operation of any temporary pumping system, when required to maintain sewer flows in the existing system, shall be the CONTRACTOR's responsibility. Demonstrate experience in the design and operation of temporary bypass pumping systems or employ the services of a vendor who can demonstrate this experience. The CONTRACTOR or vendor shall provide at least five (5) references of projects of a similar size and complexity as this project performed within the past three (3) years. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction and not interrupt existing wastewater service nor cause road closures.
- 1.08. DELIVERY, STORAGE, AND HANDLING
  - A. Section 01 55 00 - Site Access and Storage.
  - B. Coordinate material deliveries with the manufacturer/supplier. Handle and store all materials in accordance with the manufacturer's recommendations using methods that will prevent damage to the materials. Further, all manhole components shall be handled and stored in accordance with ASTM C891.
  - C. Transport:
    - 1. Unload pipe and appurtenances so as to avoid deformation or other injury thereto. Pipe shall not be placed within pipe of a larger size and shall not be rolled or dragged over gravel or rock during handling. If any defective material is discovered after installation,

remove, and replace with sound pipe or repair in an approved manner at no additional cost to the OWNER.

- D. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
  - E. Storage:
    - 1. Store materials according to manufacturer instructions.
    - 2. Block individual and stockpiled pipe lengths to prevent moving.
    - 3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
    - 4. Store plastic materials out of sunlight.
    - 5. Store all pipe and appurtenances on sills above storm drainage level and deliver for laying after the trench is excavated.
  - F. Protection:
    - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
    - 2. Plastic materials shall be supported to prevent sagging and bending.
    - 3. Plastic materials shall be covered with tarps.
    - 4. Provide additional protection according to manufacturer instructions.
    - 5. When any material is damaged during transporting, unloading, handling, or storing, the undamaged portions may be used as needed, or, if damaged sufficiently, the ENGINEER will reject the material as being unfit for installation. The ENGINEER will reject any ductile iron pipe with a damaged cement mortar lining.
- 1.09. EXISTING CONDITIONS
- A. Field Measurements:
    - 1. Verify field measurements prior to fabrication.
    - 2. Indicate field measurements on Shop Drawings.
  - B. Existing Service:
    - 1. Interruption of Existing Sanitary Sewerage Service: The interruption of sewer flows within the collection system or service to any occupied structure or facility will not be permitted unless specifically approved by the utility OWNER. Maintain sewer flows at all times.
    - 2. When by-pass pumping of sewer flows is necessary, submit a by-pass pumping work plan to the ENGINEER and utility OWNER as specified.

## PART 2 PRODUCTS

### 2.01. GENERAL

- A. All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout.
- B. As particular specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number except provisions in revised specifications which are clearly inapplicable.

## 2.02. SANITARY SEWERAGE PIPING

### A. Gaskets

- 1. Gasket material shall be Styrene Butadiene Copolymer (SBR) unless otherwise noted.

### B. Ductile Iron Pipe:

- 1. All ductile iron pipe shall conform to ASTM A746 and be Pressure Class 350 unless otherwise specified. Class numbers or pressure rating shall be clearly marked on the pipe and fittings at the factory.
- 2. Ductile iron pipe shall be of the size indicated on the Drawings and shall be designed in accordance with AWWA C150 and manufactured in accordance with AWWA C151.
- 3. Bituminous Outside Coating
  - a. All ductile iron pipe shall have an outside pipe coating of an asphaltic material a minimum of 1 mil thickness in accordance with AWWA C151. The final coat shall be continuous and smooth being neither brittle when subjected to low temperatures nor sticky when exposed to hot sun. The coating shall adhere to the pipe at all temperatures.
- 4. Interior Lining
  - a. Unless otherwise specified, line the interior of all ductile iron pipe and fittings with a ceramic epoxy coating consisting of two-part component, amine cured novalac epoxy containing a minimum of 20% by volume ceramic pigmentation.
- 5. Joints:
  - a. Unless otherwise shown on the Drawings, pipe joints shall be push joint type.
- 6. Long Span Pipe:
  - a. "Long span" type ductile iron pipe shall be used for unsupported spans greater than 20'-0". "Long span" ductile iron pipe and associated pipe joints shall be designed by the pipe manufacturer specifically for elevated crossings with unsupported spans shown on the drawings. Submit shop drawings from the pipe manufacturer for the long span pipe. Shop drawings shall include material specifications for the pipe and joints and shall specify locations of joints with respect to the pier locations shown on the drawings. Long span ductile iron pipe shall be as manufactured by American, U.S. Pipe, or equal.

### C. PVC

- 1. All PVC pipe shall conform to Type PSM SDR-35PVC unless otherwise specified. Class and pressure rating shall be clearly marked on the pipe at the factory.

2. PVC pipe shall be of the size indicated on the Drawings and shall be designed in accordance with ASTM D3034.
3. Pipe shall be supplied in 20-foot lengths.
4. Joints:
  - a. Unless otherwise shown on the Drawings, pipe joints shall be bell-and-spigot style, with rubber-ring-sealed gasketed compression type joints.
  - b. Joints and gaskets to comply with ASTM F477 and ASTM D3212.
5. Fittings: PVC or as shown on the Drawings.

D. PVC Pressure Pipe for Gravity Sewer Applications Conforming to Water Main Standards:

1. PVC pressure pipe for gravity sewer applications conforming to water main standards shall be used where called for on the Drawings.
2. Material: Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.
3. Comply with ASTM D2241.
4. Minimum SDR 26, Pressure Rated 160.
5. Pipe shall be green in color signifying its use in a sewer application.
6. Joints
  - a. Pipe shall have an integral elastomeric-gasket bell end.
  - b. Joints and gaskets to comply with ASTM F477 and ASTM D3139.

2.03. WYE BRANCHES AND SADDLES

A. Wye Branches

1. Material: Wyes shall be of the same material and strength as the sewer mains on which they are installed.
2. PVC wyes shall conform to ASTM D3034 and DIP wyes to ASTM A536.

B. Saddles

1. Use saddle wye or tee with stainless steel clamps for taps into existing piping.
2. Saddle type fittings shall not be used on new construction.
3. Material
  - a. Saddles shall be of the same material and strength as the sewer mains on which they are installed.
  - b. Straps and hardware shall be 304 stainless-steel.
4. Saddles on PVC pipe shall comply with ASTM D3034.
5. Saddles on PVC pipe shall comply with ASTM A536.
6. Lay out holes with template and cut holes with mechanical cutter.

2.04. SERVICE LATERALS

- A. Unless otherwise specified in the Plans and/or Specifications, service laterals shall be constructed of 4-inch diameter Schedule 40 PVC pipe or Class 350 psi ductile iron pipe, including the cleanout stack.
- B. PVC pipe shall comply with ASTM D1785.

2.05. FLEXIBLE COUPLINGS

- A. The use of flexible couplings will not be allowed on a new gravity system unless specifically called for on the Drawings.
- B. In general, during the rehabilitation of existing sewer lines, the use of appropriate transition couplings shall be permitted as approved by the ENGINEER. All changes in pipe size within the gravity sewer collection system shall require the installation of a manhole as specified elsewhere.
- C. Couplings shall comply with the following:
  - 1. Material: Shielded rubber sleeve with a stainless-steel shear ring and clamps
  - 2. Sleeve shall comply with ASTM C425 and ASTM C1173. Shear ring shall comply with ASTM A240.
  - 3. Accessories: Clamps shall be included with nut and bolt or worm drive take-up fasteners. "O" ring-type seals shall be provided under each sealing clamp to prevent slippage and provide a positive seal.
  - 4. The gap between the pipe sections being jointed shall not exceed 0.25 inches.
- D. Only electro-fusion couplings shall be used when connecting HDPE pipe.

2.06. FLEXIBLE PIPE BOOTS FOR MANHOLE PIPE ENTRANCES

- A. Description:
  - 1. Material: Ethylene-propylene-diene terpolymer (EPDM).
  - 2. Comply with ASTM C923.
  - 3. Attachment: stainless-steel clamp and hardware.
  - 4. Deflection: permit at least an 8° deflection from the centerline of the opening in any direction while maintaining a watertight connection.
  - 5. Seal: Joints shall be watertight under a 30-foot head of water.

2.07. CONCRETE ENCASEMENT AND CRADLES

- A. Concrete:
  - 1. Strength: 4,000 psi at 28 days.
  - 2. Air entrained.
  - 3. Finish: Rough troweled.
  - 4. Concrete shall be as specified.

2.08. MATERIALS

- A. Bedding and Backfill:

1. General: No rock, boulders, stone, or debris larger than four inches shall be allowed in the bedding or backfill material. Deficient or unsuitable bedding or backfill material shall be replaced or substituted with suitable bedding or backfill material. Excavated material intended for use as bedding or backfill shall not be used if exceedingly wet nor shall trenches be backfilled if flooded or excessively wet.
2. Stone: Stone used for pipe bedding and trench stabilization shall meet the gradation requirements of standard aggregate size No. 67.
3. Soil: Soils for bedding and backfill are described in the ASTM D2487 Figure 1 soils classification chart, and, for purposes of these Specifications, are grouped into five (5) categories as follows, according to their suitability
  - a. Class I Soil -Angular, 6 to 40 mm ( $\frac{1}{4}$ " to  $1\frac{1}{2}$ "), graded stone, including a number of fill materials that have regional significance, such as coral, slag, cinders, crushed stone, and crushed shells.
  - b. Class II Soil - Coarse sands and gravels with maximum particle size of 40 mm ( $1\frac{1}{2}$ "), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW, and SP are included in this class.
  - c. Class III Soil - Fine sand and clayey gravels, including fine sands, sand clay mixtures, and gravel clay mixtures. Soil types GM, GC, SM, and SC are included in this class.
  - d. Class IV Soil Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH, and CL are included in this class. These materials are not recommended for bedding, haunching, or initial backfill.
  - e. Class V Soil - Includes the organic soil types OL, OH, and PT, as well as soils containing frozen earth, debris, rocks larger than  $1\frac{1}{2}$  inches in diameter, and other foreign materials. These materials are not recommended for bedding, haunching, or initial backfill for any of the accepted pipe materials.

### PART 3 EXECUTION

#### 3.01. EXAMINATION

- A. Verify that excavation base is ready to receive Work of this Section.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.
- C. Existing Utilities
  1. All utility Owners shall be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. Utility Owners who are members of NC OneCall (NC 811) may be notified by calling 811 (toll free) before any excavation or drilling. The CONTRACTOR will be fully responsible for damage to any utilities if the Owners have not been properly notified as required by the Underground Damage Prevention Act. All damage to such structures and pipelines and all damage to property or persons resulting from damage to such structures and pipelines shall be borne by the CONTRACTOR and shall be completely repaired within a reasonable time. No claim

shall be made against the OWNER for damage or delay of the work on account of the proximity of, or the leakage from, such structures and pipelines. Where high pressure gas lines are to be crossed, they shall be uncovered by hand excavation methods before other excavation near them is started.

2. Where required by the Contract Documents, excavate to determine the precise location of utilities or other underground obstructions which are shown on the Plans and/or marked by the utility Owners. Such location and excavation shall be at least 500 feet ahead of construction, unless otherwise noted.
3. Utility Owners may, at their option, have representatives present to supervise excavation in the vicinity of their utilities. The cost of such supervision, if any, shall be borne by the CONTRACTOR.
4. When underground obstructions not shown on the Plans are encountered, promptly report the conflict to the ENGINEER and do not proceed with construction until the conflict is resolved.
5. Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the ENGINEER before construction proceeds.

### 3.02. PREPARATION

#### A. Preconstruction Site Photos:

1. As specified in Section 01 39 00 - Pre-Construction Video.
2. Take photographs along centerline of proposed pipe trench; minimum one photograph for each fifty (50) feet of pipe trench.
3. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.
4. Include Project description, date taken, and sequential number on back of each photograph.

#### B. Protect and support existing utilities and appurtenances.

#### C. Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper equipment for lowering sections of pipe into trenches.

#### D. Provide tools, implements, and facilities for the safe prosecution of pipe laying in accordance with manufacturer requirements and these specifications. All pipe and other materials used in the laying of pipe will be lowered into the trench piece by piece by means of suitable equipment in such a manner to prevent damage to the pipe, materials, to the protective coating on the pipe materials, and to provide a safe working condition to all personnel in the trench. Each piece of pipe being lowered into the trench shall be clean, sound and free from defects. It shall be laid on the prepared foundation, as specified elsewhere to produce a straight line on a uniform grade, each pipe being laid so as to form a smooth and straight inside flow line. Pipe shall be removed at any time if broken, injured, or displaced in the process of laying same, or of backfilling the trench.

#### E. When cutting short lengths of pipe, a pipe cutter, as recommended by the manufacturer, will be used and the cut shall be made at right angles to the centerline of the pipe. In the

case of push on joints, the cut ends shall be tapered with a portable grinder, in accordance with manufacturer guidelines.

### 3.03. INSTALLATION

#### A. Installing Pipe online and Grade:

1. Excavate pipe trench as specified.
2. Excavate to lines and grades as indicated on Drawings.
3. Dewater excavations where required to maintain dry conditions and to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified.

#### B. Bedding and Backfill:

1. Place bedding material (No. 67 stone) to establish the required invert elevation and pipe grade.
2. Work bedding material carefully around pipe to ensure adequate haunching.

#### C. PVC Pipe:

1. After the joint has been made, backfill to top of pipe with No. 67 stone material. Do not allow the pipe to shift. Additional bedding requirements outlined in project drawings shall be followed.

#### D. Ductile Iron Pipe:

1. After joint has been made, backfill to top of pipe using Class I or Class II soils or No. 67 stone. Do not allow pipe to shift. Additional bedding requirements outlined in project drawings shall be followed.

#### E. Backfill and Compaction:

1. Backfill in 6 to 12-inch lifts. Tamp each lift carefully and uniformly so as to eliminate the possibility of lateral displacement of the pipeline.
2. Compact pipe bedding and embedment material to 95% Standard Proctor.

#### F. Piping:

1. Pipe is to be installed in strict accordance with the manufacturer's recommendations and the contract specifications. The ENGINEER may augment any manufacturer's installation recommendations if, in his opinion, it will best serve the interest of the OWNER.
2. Install pipe to grades and invert elevations indicated on Drawings.
3. Begin at downstream end of system and progress upstream.
4. Lay gravity sewer pipe with the bell ends in the upgrade direction.
5. All pipe laid on a grade of twenty (20) percent or greater shall require thrust blocking or keying as shown on the drawings and standard details.
6. Plug end of piping at end of each day and when work stops. No trench water or other material shall be permitted to enter the pipe. Clear interior of piping and manholes of



dirt and debris as work progresses. If water is in the trench do not remove the plug until the danger of mud or earth entering the pipe has passed.

7. Backfill and compact as specified.
8. Do not displace or damage pipe when placing and compacting backfill.
9. Ductile Iron Gravity Sewer
  - a. Comply with ASTM A746 and AWWA C600
10. PVC Gravity Sewer
  - a. Comply with ASTM D2321 and ASTM F1668
  - b. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

G. Connections to Existing Manholes:

1. Connect to new manholes at precast inverts using the integrally cast neoprene boot and following manufacturer's guidelines. When new inverts must be made in manholes, use concrete core saw, pneumatic hammers, chipping guns, or sledgehammers shall not be used to form new inverts.
2. Install watertight neoprene gasket and seal annular space with nonshrink concrete grout.
3. Prevent construction debris from entering existing sewer line when making connection.

H. Wye Branches and Saddles:

1. Concurrent with pipe-laying operations, install service connections using appurtenance indicated and at locations indicated on Drawings.

I. Sanitary Laterals:

1. Construct laterals from service connection to terminal point at right-of-way or edge of permanent easement. Terminate lateral with clean-out in accordance with detail.
2. Minimum Depth of Cover over Piping: two (2) feet.
3. Minimum Separation Distance between Laterals: five (5) feet.
4. Minimum residential sewer service slope: two (2) percent.
5. Install watertight plug at termination of lateral, braced to withstand pipeline test pressure.

J. PE Encasement:

1. Encase piping in PE as indicated to prevent contact with surrounding backfill material.
2. Comply with AWWA C105.
3. Terminate encasement three (3) to six (6) inches above ground where pipe is exposed.

3.04. ABANDONMENT OF EXISTING SEWERS AND MANHOLES

- A. Manholes which are to be abandoned shall first have both influent and effluent lines plugged inside the manhole with watertight masonry or concrete. The manhole will then be filled with non-compressible material (crushed stone or materials approved by the

ENGINEER), to a point not less than three (3) feet below the finish grade. The remainder of the manhole shall be broken down and removed. The excavation shall be backfilled to finish grade.

- B. Abandoned mains at active manholes shall be completely disconnected from the manhole by cutting the pipe outside the manhole and then plugging the abandoned main and the manhole wall with watertight masonry. The invert shall then be rebuilt to conform to new flow pattern.
- C. The minimum length of watertight masonry and concrete plugs will be the diameter of the abandoned pipe plus one (1) foot.

### 3.05. REINSTATING EXISTING SEWER SERVICE LINES

- A. Where existing sewer mains are being rehabilitated, sewer service lines shall be constructed for each property that is occupied by a business or dwelling if it is currently served by the system being rehabilitated.
- B. The CONTRACTOR shall be responsible to locate and connect all existing sewer service lines to the new main. In the event a service is missed during construction, return to the site, and perform all work necessary to reinstate the connection. The CONTRACTOR will be compensated in accordance with the original contract unit pricing; however, re-mobilization to the site will not be paid for. In addition, the CONTRACTOR shall be responsible for any costs associated with a sanitary sewer overflow and associated damage to public or private property through the omission of reinstating an active sewer service.
- C. Service lines four (4) inches or less in diameter shall be tapped into the sewer main, not into a manhole. Service connections six (6) inches or greater shall only be made into an existing or proposed manhole, unless otherwise approved by the ENGINEER.

### 3.06. TOLERANCES

- A. Maximum Variation from Indicated Slope: 1/8 inch in ten (10) feet but installed slope shall never be less than the minimum slope for the pipe size.

### 3.07. FIELD QUALITY CONTROL

- A. Pipe Testing: As specified.

END OF SECTION 333111

## SECTION 333123 - SANITARY SEWERAGE FORCE MAIN PIPING

### PART 1 GENERAL

#### 1.01. SUMMARY

##### A. Scope of Work:

1. Furnish all labor, equipment, materials, and incidentals necessary to install and complete installation of sanitary sewerage force main piping and appurtenances in accordance with the plans. All pipe and appurtenance material shall be of the type and class specified herein.

##### B. Section Includes:

1. Force mains.
2. Bedding.

#### 1.02. REFERENCE STANDARDS

##### A. American Association of State Highway and Transportation Officials:

1. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb Rammer and an 18-in. Drop.

##### B. American Society of Mechanical Engineers:

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

##### C. American Water Works Association:

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153 - Ductile-Iron Compact Fittings.
8. AWWA C206 - Field Welding of Steel Water Pipe.
9. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances.
10. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
11. AWWA C606 - Grooved and Shouldered Joints.
12. AWWA M23 - PVC Pipe – Design and Installation.
13. AWWA M41 - Ductile Iron Pipe and Fittings.

##### D. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
3. ASTM A536 - Standard Specification for Ductile Iron Castings.
4. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheet.
5. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
6. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
7. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
8. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
9. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
10. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

1.03. COORDINATION

- A. Coordinate Work of this Section with utility OWNER and the ENGINEER.
- B. Do not interrupt service to facilities occupied by OWNER or others unless approved by the ENGINEER and OWNER no fewer than 72 hours in advance of proposed interruption and after arranging to provide temporary sewer service.

1.04. SUBMITTALS

- A. Section 01 33 00 - Electronic Submittal
- B. Product Data: Submit product technical information regarding pipe materials, pipe fittings, valves, and other appurtenances.
- C. Product technical information shall be furnished to the ENGINEER for his review and approval prior to installation of any materials. The ENGINEER may augment the technical information or product or request substitute products and technical information if, in his opinion, it will best serve the interest of the OWNER.
- D. Manufacturer's Certificate: If requested, provide certification that the products meet or exceed specified requirements.
- E. Manufacturer Instructions: If needed, submit special procedures required to install specified products.
- F. Field Quality-Control Submittals: Indicate results of CONTRACTOR-furnished tests and inspections.
- G. Preconstruction Photographs and/or Video: Submit digital files of photographs and/or video of Work areas and material storage areas, as specified in Section 01 39 00 – Preconstruction Video.

1.05. CLOSEOUT SUBMITTALS

- A. Section 01 72 00 - Project Record Documents.
- B. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust restraints, and elevations.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06. QUALITY ASSURANCE

- A. Perform Work according to 15A NCAC 02T and the following requirements:
  - 1. Comply with all requirements of utility OWNER.
  - 2. Comply with all standards of authorities having jurisdiction for public sanitary sewerage, including materials, installation, testing, and disinfection.

1.07. QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience. Upon request of the ENGINEER, Manufacturer shall provide documentation of experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience in installation of necessary materials. Upon request of the ENGINEER, Installer shall provide documentation of experience.

1.08. DELIVERY, STORAGE, AND HANDLING

- A. Section 01 55 00 - Site Access and Storage.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Storage:
  - 1. Handle and store materials according to manufacturer instructions.
  - 2. Block individual and stockpiled pipe lengths to prevent moving.
  - 3. Do not place pipe or pipe materials on private property without documented written permission or in areas obstructing pedestrian or vehicle traffic.
  - 4. Store all pipe and appurtenances on sills above storm drainage level and deliver for laying after the trench is excavated.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Plastic materials shall be supported to prevent sagging and bending.
  - 3. Plastic materials shall be covered with tarps if exposed to the elements for extended periods of time.
  - 4. Provide additional protection according to manufacturer instructions.

1.09. EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.01. GENERAL

- A. All materials shall be first quality with smooth interior and exterior surfaces, free from cracks, blisters, honeycombs, and other imperfections, and true to theoretical shapes and forms throughout. All materials shall be subject to the inspection of the ENGINEER at the plant, trench, or other point of delivery, for the purpose of culling and rejecting materials which do not conform to the requirements of these specifications. Such material shall be marked by the ENGINEER and the CONTRACTOR shall remove it from the project site upon notice being received of its rejection.
- B. As particular specifications are cited, the designation shall be construed to refer to the latest revision under the same specification number, or to superseding specifications under a new number except provisions in revised specifications which are clearly inapplicable.

2.02. FORCE MAIN PIPING

A. Gaskets

1. Gasket material shall be Styrene Butadiene Copolymer (SBR) unless otherwise noted.

B. Ductile-Iron Pipe:

1. Ductile iron pipe shall be of the size indicated on the Drawings and shall be in accordance with AWWA C150 and manufactured in accordance with AWWA C151.
2. Class numbers or pressure rating shall be clearly marked on the pipe and fittings at the factory.
3. Bituminous Outside Coating
  - a. All ductile iron pipe shall have an outside pipe coating of an asphaltic material a minimum of 1 mil thickness in accordance with AWWA C151. The final coat shall be continuous and smooth being neither brittle when subjected to low temperatures nor sticky when exposed to hot sun. The coating shall adhere to the pipe at all temperatures.

C. Interior Lining

1. Unless otherwise specified, line the interior of all ductile iron pipe and fittings with a ceramic epoxy coating consisting of two-part component, amine cured novalac epoxy containing a minimum of 20% by volume ceramic pigmentation.

D. Joints

1. Slip Joints (Push-on)
  - a. Unless otherwise specified by the ENGINEER, pipe joints shall be slip-joint type.
  - b. Comply with AWWA C111.

- c. Bells of “slip” joint pipe shall be contoured to receive a bulb-shaped circular rubber gasket, and plain ends shall have a slight taper to facilitate installation. The gasket and associated lubricant shall be furnished by the pipe manufacturer.

2. Mechanical Joints

- a. Comply with AWWA C111.
- b. Bolts for mechanical joints shall be high grade steel, low alloy type, with tee head and American Standard threads. Mechanical joint gland shall be ductile or gray iron and shall utilize a plain rubber gasket.
- c. Bolted mechanical pipe joints shall be used under all concrete structures and between all treatment structures for underground piping.

3. Flanged Joints

- a. Comply with AWWA C110, C115, and ASME B16.1.
- b. Flanged pipe shall have flanges with long hubs, shop fitted on the threaded end of the pipe.
- c. Where required, flanges shall be tapped for stud bolts. Flanges shall be accurately faced at right angles to the pipe axis and shall be drilled smooth and true, and covered with coal tar pipe varnish or otherwise protected against corrosion of flange faces. Flange faces shall be cleaned to bare metal with wire brushed before installation of pipe.
- d. Ductile iron flanged joint pipe shall be as specified by the ENGINEER. Pipe shall be ordered in lengths needed as no pipe shall be cut, threaded, or flanged in the field. All pipe shall have Class 125 flanges unless otherwise specified.
- e. Flanged joints shall be made with through bolts of the required size. Bolts shall be zinc plated, with good and sound, well-fitting threads, so that the nuts may be turned freely by hand.
- f. Flanged joints shall be made up using only full-face gaskets with a minimum thickness of 1/8-inch. Ring gaskets are not acceptable. Gasket material shall be rubber or approved equal as recommended by the Manufacturer.
- g. Connecting flanges shall be in proper alignment and no external force shall be used to bring them together.

4. Restrained Joints

- a. Restrained joints shall be the boltless type to include ductile iron locking segments and rubber retainers.
- b. Restrained pipe and fittings shall be Flex-Ring or Lok-Ring as manufactured by American Cast Iron Pipe Company, TR Flex as manufactured by US Pipe, Bolt-Lok as manufactured by Griffin Pipe Products, or approved equal.

E. Long Span Pipe

- 1. Long span type ductile iron pipe shall be used for unsupported spans greater than 20 feet.

2. "Long span" ductile iron pipe and associated pipe joints shall be designed by the pipe manufacturer specifically for elevated crossings with unsupported spans shown on the drawings.
3. The CONTRACTOR shall submit shop drawings from the pipe manufacturer for the long span pipe. Shop drawings shall include material specifications for the pipe and joints and shall specify locations of joints with respect to the pier locations shown on the drawings.
4. Long span ductile iron pipe shall be as manufactured by American, U.S. Pipe, or equal.

F. PVC: Pressure Rated PVC

1. Comply with ASTM D2241.
2. Maximum diameter: 12 inches nominal.
3. Pressure Class: Minimum allowable rating and thickness shall be Pressure Rating 200, SDR 21. Sustained pressure and quick-burst pressure testing requirements shall be in accordance with ASTM 1598 and ASTM 1599, respectively.
4. The exterior of all PVC Pipe shall bear a stamp which shows the AWWA certification, SDR, and size.
5. Fittings shall be ductile iron mechanical joint as described herein.
6. Joints:
  - a. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints meeting the requirements of ASTM D3139 and ASTM F477.
  - b. The lubricant used in making up the joints shall be furnished by the pipe manufacturer.
  - c. Seals: PVC flexible elastomeric.
  - d. Solvent-cement couplings are not permitted.

G. PVC: Scheduled PVC

1. Scheduled PVC shall be used only in above ground, interior plumbing.
2. Comply with ASTM D1784 and D1785.
3. Schedule: 40, 80, or as shown on the Drawings.
4. Fittings shall be ductile iron mechanical joint as described herein.
5. Joints:
  - a. The pipe shall have bell and spigot ends with push-on, O-ring rubber gasket, compression type joints meeting the requirements of ASTM D3139 and ASTM F477.
  - b. The lubricant used in making up the joints shall be furnished by the pipe manufacturer.
  - c. Solvent-cement couplings are only permitted on above ground or exposed piping. Solvent cement shall conform to ASTM D2564.



#### H. Transition Couplings

1. Transition couplings shall be used when the force main pipe material changes, when and where indicated on the Drawings, or as approved by the ENGINEER.
2. Material: ductile iron
3. End Connections: mechanical joint
4. Type: solid sleeve, long body
5. The appropriate gaskets shall be selected based on the outside diameters of the materials being jointed.
6. In all cases, the gap between the pipe sections being jointed shall not exceed 0.25 inches.

### 2.03. FITTINGS

#### A. General

1. All fittings for any type of force main piping shall be ductile iron, unless otherwise noted.
2. Mechanical joint fittings shall be used for subsurface installations and flanged fittings shall be used for above-ground installations.
3. Compact fittings shall be used for fittings 24-inches and smaller. Full body fittings shall be used on fittings large than 24-inches.
4. Coating and Lining:
  - a. Bituminous Coating: Comply with AWWA C110.
  - b. Cement-Mortar Lining: Comply with AWWA C104.
  - c. Ceramic Epoxy Lining: two-part component, amine cured novalac epoxy containing a minimum of 20% by volume ceramic pigmentation.

#### B. 2-inch Ductile Iron Fittings

1. Material: Grade 65-45-12 ductile iron in accordance with ASTM A536. Fittings shall have deep bell push-on joints with gaskets meeting ASTM F477. Transition gaskets are not allowed.

#### C. 3-inch through 64-inch Ductile Iron Fittings

1. Material: Ductile iron; comply with AWWA C110.
2. Compact Fittings (mechanical joint and flanged): Comply with AWWA C153.

### 2.04. UNDERGROUND PIPE LOCATION

#### A. Warning Tape

1. Provide and install an early warning detection tape above all underground piping.
2. Tape shall be 3 inches wide by 4 mils thick. Tape shall be solid green in color with continuously printed caption in black letters "CAUTION – BURIED SEWER LINE BELOW". Tape shall have a minimum tensile strength in accordance with ASTM D882.

3. Install approximately 18 inches below ground and directly over pipeline.

B. Tracer Wire

1. See Specification Section 33 27 60 - Underground Utility Detection System.

C. Tracer Wire Access Point

1. A tracer wire testing station shall be installed in every valve box.

2.05. MATERIALS

A. Bedding and Backfill:

1. General: No rock, boulders, stone, or debris larger than four inches shall be allowed in the bedding or backfill material. For PVC pipe, no material larger than two inches shall be placed within a foot of the top of the pipe. Deficient or unsuitable bedding or backfill material shall be replaced or substituted with suitable bedding or backfill material. Excavated material intended for use as bedding or backfill shall not be used if exceedingly wet nor shall trenches be backfilled if flooded or excessively wet.
2. Stone: Stone used for pipe bedding and trench stabilization shall meet the gradation requirements of standard aggregate size No. 67.
3. Soil: Soils for bedding and backfill are described in the ASTM D2487 Figure 1 soils classification chart, and, for purposes of these Specifications, are grouped into five (5) categories as follows, according to their suitability
  - a. Class I Soil - Angular, 6 to 40 mm ( $\frac{1}{4}$ " to  $1\frac{1}{2}$ "), graded stone, including a number of fill materials that have regional significance, such as coral, slag, cinders, crushed stone, and crushed shells.
  - b. Class II Soil - Coarse sands and gravels with maximum particle size of 40 mm ( $1\frac{1}{2}$ "), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW, and SP are included in this class.
  - c. Class III Soil - Fine sand and clayey gravels, including fine sands, sand clay mixtures, and gravel clay mixtures. Soil types GM, GC, SM, and SC are included in this class.
  - d. Class IV Soil - Silt, silty clays, and clays, including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH, and CL are included in this class. These materials are not recommended for bedding, haunching, or initial backfill.
  - e. Class V Soil - Includes the organic soil types OL, OH, and PT, as well as soils containing frozen earth, debris, rocks larger than  $1\frac{1}{2}$  inches in diameter, and other foreign materials. These materials are not recommended for bedding, haunching, or initial backfill for any of the accepted pipe materials.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that existing utility main size, location, and invert are as indicated on Drawings.

B. Existing Utilities

1. The CONTRACTOR shall be required to excavate to determine the precise location of utilities or other underground obstructions which are shown on the Plans and/or marked by the utility Owners. Such location and excavation shall be at least 500 feet ahead of construction, unless otherwise noted.
2. All utility Owners shall be notified prior to excavation as required by the 1985 Underground Damage Prevention Act. Utility Owners who are members of NC 811 may be notified by calling 811 (toll free) before any excavation or drilling. The CONTRACTOR will be fully responsible for damage to any utilities if the Owners have not been properly notified as required by the Underground Damage Prevention Act. All damage to such structures and pipelines and all damage to property or persons resulting from damage to such structures and pipelines shall be borne by the CONTRACTOR and shall be completely repaired within a reasonable time. No claim shall be made against the OWNER for damage or delay of the work on account of the proximity of, or the leakage from, such structures and pipelines. Where high pressure gas lines are to be crossed, they shall be uncovered by hand excavation methods before other excavation near them is started.
3. Utility Owners may, at their option, have representatives present to supervise excavation in the vicinity of their utilities. The cost of such supervision, if any, shall be borne by the CONTRACTOR.
4. Conflicts with underground utilities may necessitate changes in alignment and/or grade of this construction. All such changes will be approved by the ENGINEER before construction proceeds.
5. When underground obstructions not shown on the Plans are encountered, the CONTRACTOR shall promptly report the conflict to the ENGINEER and shall not proceed with construction until the conflict is resolved.

3.02. PREPARATION

A. Preconstruction Site Documentation:

1. Record video and/or photographs along centerline of proposed pipe trench; minimum one photograph for each 50 feet of pipe trench.
2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing site features.
3. Include Project description, date taken, and sequential number on back of each photograph.

B. Pipe Cutting:

1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
3. Grind edges smooth with beveled end for push-on connections.
4. In the case of slip joint pipe, the cut ends shall be tapered with a portable grinder or coarse file to match the manufactured taper.

- C. Remove scale and dirt on inside and outside of pipe before assembly.
  - D. Prepare pipe connections to equipment in accordance with equipment manufacturer's requirements.
- 3.03. INSTALLATION
- A. General:
    - 1. Pipe and fittings shall be laid as shown on the Drawings.
    - 2. CONTRACTOR shall provide all materials, labor, tools, equipment, and incidentals required for the excavation, installation, backfilling and testing of sewer force mains and associated appurtenances.
    - 3. Do not use flanged pipe, fittings, or valves or unions for underground (buried) piping. Fittings and valves for underground (buried) piping shall be mechanical joint. Flanged pipe, fittings and valves and unions shall be used on aboveground piping and piping in vaults.
    - 4. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used as specified, unless otherwise indicated.
    - 5. All pipe fittings, valves, hydrants and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Any defective, damaged, or unsound material shall be repaired or replaced as directed by the ENGINEER.
  - B. Bedding and Backfill:
    - 1. General:
      - a. Place bedding material to the level shown on the Drawings.
      - b. Work material carefully around the pipe to ensure adequate haunching.
    - 2. PVC Pipe:
      - a. After excavation is completed, bed with 4 inches of Class I, Class II, or No. 67 stone material to bring trench bottom to grade. Excavated native material may be used if material conforms to this specification.
      - b. After the joint has been made, backfill to spring line of pipe with Class I, Class II, or No. 67 stone material. Additional bedding requirements are outlined in project drawings and shall be followed.
    - 3. Ductile Iron Pipe:
      - a. After excavation and the joint has been made, bed with 4 inches of Class I, II, III, or IV bedding material. This may be the native trench bottom if material conforms to this specification
      - b. Compact backfill by hand tamping under the haunches of the pipe barrel to assure a firm circular bearing surface for the pipe taking care not to move or raise the pipe or in any way create a non-uniform bearing surface. Additional bedding requirements outlined in project drawings and shall be followed.
    - 4. Compaction:

- a. Backfill in 6- to 12-inch lifts. Tamp each lift carefully and uniformly so as to eliminate the possibility of lateral displacement of the pipeline.
- b. Compact pipe bedding and embedment material to 95% Standard Proctor.

C. Piping:

1. Comply with AWWA C600, C605, M41, and M23.
2. Handle and assemble pipe according to manufacturer instructions.
3. Steel Rods, Bolts, Lugs, and Brackets: Coat buried steel before backfilling.
4. Pipe Separation
  - a. Pipe Separation with Water Mains
    - 1) Lateral Separation of Sewers and Water Mains
      - a) Maintain 10 feet of horizontal separation between water main and sewer piping.
    - 2) If local conditions or barriers prevent a 10-foot later separation:
      - a) The sanitary piping shall be laid in a separate trench with the elevation of the top of the sanitary piping at least 18 inches below the bottom of the water main; or
      - b) The sanitary piping shall be constructed of ductile iron pipe with watertight joints.
    - 3) Crossing Sanitary Piping under a Water Main
      - a) The sanitary piping shall be laid at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer, unless local conditions or barriers prevent an 18-inch vertical separation in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.
    - 4) Crossing Sanitary Piping over a Water Main
      - a) The sanitary piping shall be laid at such an elevation that the bottom of the sanitary piping is at least 18 inches above the top of the water main, unless local conditions or barriers prevent an 18-inch vertical separation in which case both the water main and sewer shall be constructed of ferrous materials and with joints that are equivalent to water main standards for a distance of 10 feet on each side of the point of crossing.
      - b) Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.
      - c) That the length, minimum 20 feet of the sanitary piping be centered at the point of crossing so that joints shall be equidistant and as far as possible from the water line.
  - b. Pipe Separation with Other Utilities and Features
    - 1) Horizontal Separation

- a) Storm Sewers - 5 feet
- b) Water Supply - 100 feet (WS-I Waters, Class I or Class II impounded 4) reservoirs)
- c) Water Supply - 50 feet (WS-II, WS-III, B, SA, ORW, HQW or SB Waters – from Normal High Water)
- d) Designated Trout Streams - 25 feet
- e) Other Stream, Lake, or Impoundment - 10 feet
- f) Building Foundation - 5 feet
- g) Basement - 10 feet
- h) Ground Water Lowering and Surface Drainage Ditch - 10 feet
- i) Swimming Pool - 10 feet
- j) Private Wells - 25 feet
- k) Public Wells - 50 feet
- 2) Vertical Separation
  - a) Storm Sewers - 18 inches Vertical
  - b) Cable - 18 inches Vertical
  - c) Power - 18 inches Vertical
  - d) Gas - 18 inches Vertical

5. Pipe Insulation

- a. All outdoor piping 4 inches in diameter and smaller which is not buried shall be insulated except where specifically stated otherwise on the Drawings or in these specifications.
- b. Provide heat tape and controls as recommended by manufacturer for temperatures down to -10° F. This requirement shall also apply to piping in vaults.
- c. The piping shall be insulated with 1-inch thick polyfoam with the insulation laminated to an outside jacket of PVC with a finished color of white. The material shall be furnished in standard 25-foot rolls with insta-grip closure.
- d. Fittings and valves shall be insulated with preformed white insulated fitting covers with 1 inch thick polyurethane foam insert.
- e. Pipe insulation shall be wrapped around pipe and trac locked down in position. Insulation shall be held in place by sealing trac with fastener-weld or equal.
- f. All butt joints and fitting covers shall be sealed with silicone sealant and then taped in place to provide a vapor barrier.
- g. Installation procedures and accessory materials shall all be in accordance with the pipe insulation manufacturer's written instructions.

6. Thrust Block Installation

- a. All turns, fittings, etc., that induce pressure which would cause separation of pipe, breakage, etc., shall be provided with adequate thrust blocks. Thrust blocks shall be constructed to the minimum dimensions shown on the drawings or as directed by the ENGINEER.
- b. Thrust blocks shall be made of ready-mix concrete with a minimum compressive strength at 28 days of not less than 3,000 PSI when tested in accordance with ASTM C39. Sakrete or any similar material will not be permitted under any circumstances.
- c. Blocking shall be formed and placed in such a manner that the pressure to be exerted at the point of blocking shall be transferred to firm, undisturbed earth. Where possible, the concrete shall be placed so that the fitting joints will be accessible for repair.
- d. All bolts and pipe joints shall be protected against contact with thrust block concrete by the installation of a 20-mil polyethylene film placed between the fittings and the concrete. Where any section of a main is provided with concrete thrust blocks, the hydrostatic pressure test shall not be made until seven days after installation of the concrete thrust blocks unless otherwise approved by the ENGINEER. Where trench conditions are, in the opinion of the ENGINEER, unsuitable for thrust blocks, the CONTRACTOR shall provide steel tie rods and socket clamps to adequately anchor the piping. All tie rods and clamps shall be given a bituminous protective coating or shall be galvanized.
- e. The CONTRACTOR shall also be responsible for any damage or repairs caused by blow-outs of any insufficiently blocked pipe.

7. Joint Construction

- a. All pipe joints shall be constructed in strict accordance with the pipe manufacturer's specifications and materials and any deviation must have prior approval of the ENGINEER.
- b. The maximum deflection per joint of flexible joint pipe shall be that deflection recommended by the manufacturer. However, at no time will a deflection greater than 3 degrees (11 inches in an 18'-0" pipe section) be allowed.
- c. Mechanical Joints
  - 1) Clean last 8 inches outside the spigot, and the inside of the bell of mechanical joint pipe to remove oil, grit, tar (other than standard coating) and other foreign matter from the joint and then paint area clean with an approved soap solution. The ductile iron gland shall then be slipped on the spigot end of the pipe with the extension of the gland toward the socket or bell end. The rubber gasket shall be painted with the soap solution and placed on the spigot end with thick edge toward the gland.
  - 2) Push entire section of pipe forward to seat spigot end in the bell. Press gasket into place within the bell, being careful to have the gasket evenly located around the entire joint. Move ductile iron gland along the pipe into position for bolting, insert all bolts and screw nuts up tightly with fingers. Tighten all nuts with a suitable (preferably torque-limiting) wrench. Tighten nuts that are spaced 180 degrees apart alternately in order to produce equal pressure on all

parts of the gland. If effective sealing is not obtained by tightening the bolts to the specified torques, the joint shall be disassembled and reassembled after thorough cleaning.

- 3) An adapter having a fitting bell and a mechanical joint socket may be used by the CONTRACTOR when joining an existing bell and spigot to a new mechanical joint.

d. Push-on Joints

- 1) Clean gasket and spigot and inside of bell thoroughly to remove all direct and other foreign matter.
- 2) Insert gasket furnished by the pipe manufacturer into the gasket groove in the bell. Gasket shall be properly seated in the grooves provided in the pipe bell.
- 3) Using a non-toxic vegetable soap, apply a film by hand to the inside surface of the gasket that comes into contact with the entering pipe and to the first 1-inch of the spigot end of the entering pipe. Use only lubricant specified by the pipe manufacturer.
- 4) Align entering pipe with the bell to which it is to be joined. Enter the spigot end into the bell until it just makes contact with the gasket. Apply sufficient pressure to force the spigot end past the gasket up to solid contact with the bell.
- 5) When it is necessary to field cut pipe with rubber gaskets, chamfer the cut end 1/8-inch x 30 degrees and check for roundness before inserting into a rubber gasket bell.

8. Ductile-Iron Piping and Fittings: Comply with AWWA C600.

9. Grooved and Shouldered Pipe Joints: Comply with AWWA C606.

10. Field Welding Materials: Comply with AWWA C206.

- a. All exposed piping to be installed inside tanks, wet wells, vaults, and buildings shall be installed as shown on the Drawings. All exposed pipe shall be ductile iron utilizing flanged joints unless otherwise noted.
- b. All exposed ductile iron pipe, fittings and valves shall be field painted with two (2) coats of epoxy paint as recommended by the paint manufacturer. Color of paint shall be as selected by the OWNER.

11. No pipe shall be laid except in the presence of the ENGINEER or his Representative or with special permission from the ENGINEER.

12. Route pipe in straight line and re-lay pipe that is out of alignment or grade.

13. Pipe shall be removed at any time if broken, injured, or displaced in the process of laying same, or of backfilling the trench.

14. High Points:

- a. Pipe shall be installed in a manner that minimizes localized high points in the piping.
- b. If unforeseen field conditions arise that necessitate high points, install air-release valves as specified, as indicated on Drawings, or as directed by the ENGINEER.



15. Bearing:

- a. Maintain bearing along entire length of pipe.
- b. Excavate bell holes to permit proper joint installation.
- c. Do not lay pipe in wet or frozen trench.

16. Prevent foreign material from entering pipe during placement.

17. Allow for expansion and contraction without stressing pipe or joints.

18. Close pipe openings with watertight plugs during Work stoppages.

19. Cover:

- a. Establish elevations of buried piping with not less than 3 feet of cover.
- b. Measure depth of cover from final surface grade to top of pipe barrel.

D. PE Encasement:

- 1. Encase piping in PE where indicated on Drawings to prevent contact with surrounding backfill material.
- 2. Comply with AWWA C105.
- 3. Terminate encasement 3 to 6 inches above ground where pipe is exposed.

E. Backfilling: Backfill around sides and to top of pipe as specified.

3.04. FIELD QUALITY CONTROL

A. Pressure Testing: As specified.

END OF SECTION 333123



## SECTION 333216 - GRINDER PUMP STATION

### PART 1 GENERAL

#### 1.01. THE REQUIREMENT

- A. This section shall cover the furnishing and installation of the individual, package-type grinder pumping station and accessories, as required to serve the maritime education center as indicated on the drawings.
- B. The installation shall consist of fully assembled grinder pump package, including a dual (duplex) grinder pump and motor, basin assembly, internal discharge piping, check valve, shut of valve, quick-disconnect slide rail system, lift chain, high water alarm float, stainless steel level control bracket, junction box, inlet fitting and remote pump control panel.
- C. The pump basin shall be a completely factory assembled unit, requiring only minor adjustments and reassembly in the field.

#### 1.02. SUBMITTALS

- A. Shop drawings and manufacturer's literature: The prefabricated FRP pump basin manufacturer shall prepare shop drawings for the complete pump basin including structural and opening details, equipment mounting and location details, and manufacturer's cut sheets for each item of equipment in the pump basin. The main component of the submittals shall be an 8½" x 11" drawing of the complete prefabricated FRP pump basin prepared by the manufacturer. Manufacturers' cut sheets shall indicate capacities, dimensions, and materials of construction for all equipment in the prefabricated FRP pump basin.

#### 1.03. OPERATING AND MAINTENANCE MANUALS

- A. The prefabricated FRP pump basin supplier shall prepare a complete operations and maintenance (O&M) manual for the complete pump basin. The O&M manual shall include routine maintenance requirements and spare parts lists for each major item of equipment in the pump basin. The names and telephone numbers of companies where spare parts and/or trained service technicians are available shall also be included for each item of equipment.

#### 1.04. DELIVERY AND HANDLING

- A. Conditions for delivery and handling:
  - 1. The manufacturer of the prefabricated package-type grinder pumping station shall coordinate with the contractor so that the station is delivered to the jobsite on time for installation. Handling instructions shall be provided by the package station manufacturer with the contractor to insure proper handling of the package station. After delivery to the jobsite, the contractor shall store the motor control panel off the ground in a dry location until it is mounted and supplied with electrical service. The contractor shall also ensure that all pump power and control cables, as well as float cables, are protected from submergence until they are properly installed and sealed.

1.05. GUARANTEE

- A. The prefabricated package-type grinder pumping station manufacturer shall guarantee the complete prefabricated FRP pump basin to be free from defects in materials and workmanship for a period of one (1) year from the date of delivery.

1.06. MANUFACTURER

- A. The duplex grinder pump package shall be manufactured by ABS, Flygt, Hydromatic, Zoeller, or approved equal.
- B. Other manufacturers/vendors desiring to furnish the duplex package pump stations shall submit complete descriptive data on the proposed pump to the engineer not less than 14 days prior to the scheduled bid opening to allow time for evaluation by the engineer. The engineer shall then issue an addendum to list the manufacturer of pump stations that are deemed acceptable. Pump stations that are not pre-approved by the Engineer shall not be used.

PART 2 PRODUCTS

2.01. GRINDER PUMP

- A. Description and Operating Conditions
  - 1. The grinder pump shall be capable of grinding and pumping raw, unscreened sewage at the following operating condition:
    - a. Condition 1 - 28 gpm @ 78 feet TDH
- B. The grinder unit shall be capable of shearing and reducing to a fine slurry all material normally found in domestic and commercial sewage such as sanitary napkins, disposable diapers, cloth diapers, wash rags, wood, plastic, etc. The slurry shall be capable of freely passing through a 1¼" piping system including check and gate valves.
- C. The pump shall be of the centrifugal type with the rotating cutter mounted on the pump shaft directly against the impeller. The stationary cutter shall be mounted in an adjustable bottom plate. The stationary cutter shall have slots to facilitate better flow. The bottom plate shall be cast with grooves threading outward from the center opening of the plate to the outer diameter. The impeller shall be a multiple vane centrifugal type. The cutter material shall be similar to an ANSI 440C stainless steel with the addition of cobalt, vanadium, and molybdenum for superior abrasion resistance and a hardness of 58-62 Rockwell C. The cutting elements and impeller shall be designed to keep the overhung load distance to a minimum. All fasteners shall be 304 stainless-steel.
- D. The common pump and motor shaft shall be 420 stainless-steel supported on the impeller end by a heavy-duty single row ball bearing on 1.0-2.5 hp pumps, or a heavy-duty double row ball bearing on 3.5-4.0 hp pumps. The opposite end of the shaft is supported on a sealed single row ball bearing. Ball bearings shall be designed for 50,000 hours B-10 life.
- E. Shaft seals: each pump shall be equipped with two (2) seals. The lower seal (pump side) shall be of the mechanical type with silicon carbide faces. The upper seal shall be a lip type seal. The seals shall be separated by an oil chamber providing cooling and lubrication of the seals, and a barrier between the pumped fluid and the dry motor chamber.
- F. Seal failure warning system: an electric probe shall be provided in the oil chamber to detect the presence of water in the oil. A solid-state device mounted in the pump control panel

or in a separate enclosure shall send a low voltage, low amperage signal to the probe. If water enters the oil chamber in sufficient quantity to warrant concern, the probe shall activate a warning light in the control panel.

2.02. MOTOR

- A. The pump motor shall be of the submersible type, rated 4.0 horsepower, and shall operate on 208-volt, 60 Hz, three-phase power. Motor speed shall be 3,450 rpm. The motor shall be capacitor start; capacitor run type for high starting and running torque.
- B. The rotor and stator shall be enclosed in a cast iron outer housing. The stator winding shall be of the open type with class b insulation, good for 130°C (266°F) maximum operating temperature. The winding housing shall be filled with clean, high dielectric oil that lubricates bearings and seals and transfers heat from the windings and rotor to the outer shell. Air-filled motors, which do not have superior heat dissipating capabilities of oil-filled motors, shall not be considered equal.
- C. The stator shall be bolted to seal plate for easy motor replacement.
- D. The motor shall have a heat sensor thermostat and overload attached to the top end of the motor windings to stop the motor if the motor winding temperature reaches 200°F. The high temperature shutoff will cause the pump to cease operation, should a control failure cause the pump to run in a "dry" condition. The thermostat shall reset automatically when the motor cools to a safe operating temperature.

2.03. CORROSION PROTECTION

- A. All iron castings shall be pre-treated with phosphate and chromic rinse and shall be painted before machining, and all machined surfaces exposed to the sewage shall be re-painted. All fasteners shall be type 302 stainless steel.

2.04. POWER CORD

- A. The motor power cord shall be 14-7 SOOW and shall be fastened by means of a cord grip at the top of the pump. The top of the pump shall contain a waterproof junction box, which will provide space to connect the power cord to the motor leads. The motor leads shall seal between the motor housing and junction box by means of a rubber compression fitting around each wire. The power cord shall have a green carrier ground conductor that attaches to the motor frame.

2.05. PUMP BASIN (WET WELL)

- A. Fiberglass reinforced polyester pump basin: unless otherwise indicated the plastic terminology used in this specification shall be in accordance with the definitions given in American Society for Testing and Materials (ASTM) D883 - Definitions of Terms Relating to Plastics.
- B. The pump basin shall be 48" diameter with depth as shown in the drawings. The basin shall be molded of fiberglass-reinforced polyester resin manufactured by the lay-up and spray technique to assure that the interior surface is smooth and resin rich. The basin shall have a minimum wall thickness of ½-inch. A top flange and anti-flotation collar extending a minimum of 4 inches beyond the O.D. of the basin wall shall be provided.
- C. The bottom laminate shall have less than 0.75 inches of center elastic deflection (deformation) when in service in totally submerged conditions.

Maritime Education Center and Phase I Site Work  
Maritime Heritage Foundation  
The North Carolina Maritime Museum  
Department of Natural and Cultural Resources

SCO ID# 24-27956-01A  
CN Commission No. 10145  
Bid Documents; June 7, 2024

2.06. PHYSICAL PROPERTIES

- A. Pump basin FRP wall laminate: the pump basin FRP wall laminate must be designed to withstand wall collapse or buckling based on the following assumptions and third-party specifications:
  - 1. Hydrostatic pressure of 62.4 lbs. per square foot
  - 2. Saturated soil weight of 120 lbs. per cubic foot
  - 3. Soil modulus of 700 pounds per square foot
  - 4. Pipe stiffness values as specified in ASTM D3753
- B. The pump basin FRP laminate must be constructed to withstand or exceed two times the assumed loading on any depth of the pump basin.

2.07. PUMP BASIN TOP FLANGE

- A. The pump basin top flange shall have an outside diameter at least 4.0 inches greater than the inside diameter of the well.
- B. A six-hole pattern shall accommodate the mounting of a cover with at least 0.375 inches in diameter 316 series stainless steel fasteners. Non-corroding stainless steel threaded inserts shall be fully encapsulated with non-continuous mat or chopped-strand glass fiber reinforcement. The inserts shall have an offset tab to prevent stripping or spinning out when removing and reinserting cover fasteners.

2.08. STEEL ANTI-FLOATATION FLANGE

- A. The steel anti-floatation flange shall be constructed from 0.1875-inch-thick ASTM A36 structural steel plate, encapsulated in at least 0.125 inches of chopped-strand glass fiber reinforcement on all sides. The steel anti-floatation flange shall be square with outside dimensions of at least 4.0 inches greater than the pump basin inside diameter. The steel anti-floatation flange shall be attached to the pump basin bottom with chopped-strand glass fiber reinforcement. The contractor shall place the pump basin on a concrete pad and cover the entire steel anti-floatation flange. The amount of concrete shall be sufficient to prevent floatation of the pump basin based on the jobsite conditions. The steel anti-floatation flange shall not require bolt holes to secure it to the concrete pad.

2.09. PUMP QUICK DISCONNECT MOUNTING STUDS

- A. Shall be 316 stainless steel threaded studs of at least 0.375 inches in diameter shall be used. The studs shall first be threaded into the 0.1875 inches thick ASTM A36 structural steel anti-floatation flange/bottom of the pump basin and then welded into place. Once installed, the studs shall be sealed with at least two layers of non-continuous glass fiber mat or chopped-strand glass fiber reinforcement.

2.10. DISCHARGE COUPLING

- A. A 300 series stainless steel 1 1/4" NPT full coupling fully welded in the center of a 14-gauge 300 stainless steel plate, shall be factory installed with at least 0.375 inches in diameter 316 stainless steel fasteners. The pump basin wall penetrations shall be sealed with silicone sealer. A sufficient quantity and type of "Link-Seal" type modular, mechanical, interlocking, synthetic rubber links shaped to continuously fill the annular space between the

discharge pipe and the aluminum sleeve shall be used to provide a hydrostatic seal. The aluminum sleeve shall be bolted on the pump basin wall and sealed with a silicone sealer.

2.11. ELECTRICAL COUPLING

- A. A 300 series stainless steel NPT full coupling fully welded in the center of a 14-gauge 300 series stainless steel plate, shall be factory installed with at least 0.375 inches in diameter 316 stainless steel fasteners. The pump basin wall penetrations shall be sealed with silicone sealer.

2.12. INLET HUB

- A. A 4-inch nominal pipe diameter thermoplastic pipe grommet shall be field installed by the contractor in a 5-inch diameter hole in the pump basin wall. The pipe grommet shall provide mechanical seal and shall not require any secondary sealing materials.

2.13. FLOAT BRACKET

- A. The float bracket shall be fabricated from 300 series stainless steel with four (4) compression style cord grips to maintain float level position. It shall be factory installed with at least 0.375 inches in diameter 316 stainless steel fasteners. The pump basin wall penetrations shall be sealed with silicone sealer.

2.14. VENTILATION

- A. Pump basin ventilation shall comply with all applicable codes.

2.15. SLIDE RAIL ASSEMBLY

- A. The slide rail assembly shall include pump quick disconnect discharge elbow, sealing flange with rail guide, upper guiderail bracket, lifting cable and guiderails.

2.16. PUMP QUICK DISCONNECT (QDC) DISCHARGE ELBOW

- A. The pump quick disconnects (QDC) discharge elbow, made of cast iron, designed to mount directly to the pump basin floor, shall be supplied for each pump. It shall have a standard ANSI B16.1 125 lb. Flange, flat faced and drilled on the discharge side, with a machined mating pump connection. The design shall be such that the connection between the pump and QDC is made without the need for any nuts, bolts, or gaskets.

2.17. SEALING FLANGE WITH RAIL GUIDE

- A. The sealing flange with rail guide shall be mounted on each pump discharge. It shall have a machined mating flange, which matches the QDC discharge elbow. The sealing of this pump and discharge piping connection shall be accomplished by a simple linear downward motion of the pump along the guiderails culminating with the entire weight of the pumping unit supported by the QDC discharge elbow.

2.18. UPPER GUIDERAIL BRACKET

- A. The upper guiderail bracket, made from ASTM A283 D structural steel, shall align, and support the two guiderails at the top of the pump basin. It shall bolt directly to the hatch frame (or aluminum upper guiderail bracket in pump basins with solid fiberglass covers) and incorporate beveled stainless-steel inserts for secure rail installation.



2.19. LIFTING CABLE

- A. The lifting cable shall be 300 series stainless steel with a diameter of at least 3/16" and a nominal breaking strength of at least 2,500 pounds.

2.20. GUIDERAILS

- A. The guiderails shall be 2-inch Schedule 40, 300 series stainless steel pipes. There shall be two guiderails per pump to insure proper alignment with the QDC discharge elbow and stationary piping.

2.21. BASIN ACCESS HATCH

- A. The access hatch shall be constructed of 0.250 inches thick mill finish aluminum diamond plate with 316 stainless steel hardware. The access hatch shall have a recessed handle and locking pin. The hatch shall be held open in the vertical position by means of a hold open arm of corrosion resistant design. The cover shall be mounted to the pump basin with at least six 316 stainless steel fasteners of at least 0.375 inches in diameter.

2.22. BALL CHECK VALVE

- A. Ball check valves shall be designed to be fully automatic in operation and specifically suited to serve where solids, fibers or highly viscous materials are encountered. Ball check valves will have one moving part, the ball, which moves automatically out of the path of flow, providing an unobstructed smooth flow through the valve body. Upon discontinuation of flow the ball automatically rolls back to the closed position, providing a positive seal against back pressure or backflow. The ball check valve shall be constructed from corrosion resistant PVC with threaded female x female NPT connection, and a Nitrile (Buna-N) ball. Ball check valves shall be designed to be maintenance free and suited for installation in the horizontal or vertical position. In the horizontal position 20 feet of static head is recommended for proper seating. In the vertical position 10 feet is recommended. The valve shall be so constructed that by unscrewing and lifting off the cover, the ball may be removed and replaced without removing the valve from the line. Ball check valves will have a sinking ball.

2.23. SHUT OFF VALVE

- A. A pvc true union ball type shut off valve with Teflon seats shall be furnished as an integral part of the internal pipe assembly. If the discharge depth is more than 2 feet from the surface an extension handle shall be supplied.

2.24. PUMP CONTROL PANEL

A. Enclosure

- 1. The control equipment enclosure shall be a NEMA 4X and be of suitable size to house all components for a duplex pump set up. A locking hasp shall be provided in addition to screw clamp type latches. Enclosure shall be fabricated from 14-gauge stainless steel. The top of the enclosure shall serve as a drip shield and the seam free sides shall prevent rain and sleet from entering. The inner panel shall be made of 12-gauge stainless steel.

B. Hinged Inner Door

- 1. An inner door shall be furnished. Overload reset push buttons, circuit breakers, switches, and pilot lights shall be the only components accessible with the door closed. The door shall be hinged and may be opened when service is required.

C. Line Terminal Block

1. Terminal block shall be furnished with properly sized line lugs to accept the main power source entering the control panel. Load lugs shall be adequate to accept all required load side wiring requirements. All live parts shall be fully shielded.

D. Motor Circuit Breaker (208 Vac)

1. A properly sized, molded case, thermal-magnetic circuit breaker shall be provided for each pump motor. Line and load sides shall be equipped with lugs properly sized for the horsepower and current rating of the motor(s). The minimum interrupting rating shall be 18,000 RMS symmetrical amps but shall be greater than the available fault current.
2. Motor circuit breakers to have an integral lockout feature in compliance with the latest revision of the NEC and OSHA lockout/tagout requirements.

E. Transformer Primary Circuit Breaker

1. A properly sized, two-pole, molded case circuit breaker shall be furnished ahead of the control power 120-vac power transformer for short circuit protection and disconnecting power to the transformer. The circuit breaker shall conform to the specifications for the motor circuit breaker(s).

F. Control Power Transformer

1. An industrial quality control transformer shall be furnished to provide control voltage. The transformer shall be furnished to provide adequate KVA rating to provide 120-Vac power for all items required in the control and alarm circuits. The transformer shall be protected in its secondary by a properly sized fuse and/or circuit breaker(s).

G. Motor Controller

1. the motor controller shall be “across the line” starters.

H. Elapsed Time Meters

1. Six-digit, non-resettable elapsed time meters shall be mounted in the control panel enclosure to record the running time of each pump.

I. Condensation Strip Heater with Thermostat

1. A strip heater shall be furnished to prevent condensation within the control panel enclosure. The heater shall be controlled by a panel mounted, adjustable thermostat.
2. Phase and voltage monitor
3. A phase failure, reversal and under voltage monitor shall be supplied to prevent the motors from running under low voltage, phase loss, or phase reversal conditions. The monitor shall lock out the control circuit until the problem is corrected and automatically reset.

J. Lightning Arrestor

1. Suitable lightning arrestors shall be provided to protect motors and control equipment from lightning induced line surges.

K. Thru - Door Overload Reset Push Buttons

1. Overload reset push buttons shall be provided for each overload relay. Push buttons shall be mounted so that with the inner door closed, overload relays may be reset without entering the high-voltage compartment.

L. Switches

1. Heavy-duty industrial grade oil-tight switches shall be provided for each pump for "Hand/Off/Automatic" operation selection. All switch components shall be made of corrosion resistant metals and polyesters. Contact blocks shall be made of see-through polycarbonate for simplified inspection of contacts. Cams and strokers shall be Teflon impregnated for abrasion free service without lubrication. The switches shall be labeled "h-o-a" and have a voltage rating of 120 vac.

M. Pilot Lights

1. Full voltage heavy-duty industrial grade oil-tight pilot lights shall be provided. All pilot light components shall be made of corrosion resistant metals and polyesters. An insulated socket shall be furnished to eliminate the possibility of shock during bulb changes. Lens shall be made of Lexan and green in color. Each pilot light shall be labeled "pump 1" and "pump 2".

N. Seal Fail Alarm Circuit with Test Push Button

1. The control panel shall be equipped with a conductance actuated control relay that shall respond to current from a moisture sensor in the pump seal chamber. Relay contacts shall be rated at 16 amps minimum. All molded structural parts shall be of high mechanical and dielectric strength, structural dimensionally stable, arc resistant, thermosetting plastic. Base plate shall be high strength, die cast aluminum alloy. Solid-state type relays shall not be considered acceptable for seal fail monitoring applications. A Lexan amber alarm pilot light shall illuminate upon alarm condition. Each pilot light shall include contacts that shall allow testing the seal failure circuit and pilot light bulb by pushing.

O. Seal Failure Circuit Test Push Button (Illuminated)

1. Heavy-duty industrial grade oil-tight push buttons shall be provided for each submersible pump motor. All push button components shall be made of corrosion resistant metals and polyesters. Contact blocks shall be made of see-through polycarbonate for simplified inspection of contacts. An insulated socket shall be furnished to eliminate the possibility of shock during bulb changes. Lens shall be made of Lexan and amber in color. The push buttons shall be labeled "P1 Seal Fail" and "P2 Seal Fail", and have a voltage rating of 120 Vac.

P. Pump Alternator Circuit (for Duplex Pump Operation)

1. The electro-mechanical alternator relay shall be of industrial design specifically for use in pump applications. It shall have single-pole double-throw heavy-duty 10-amp silver cadmium oxide contacts enclosed in a transparent cover. The snap action contacts shall transfer when the unit is de-energized. The circuit shall never be closed or opened while the current is being conducted. The alternator circuit shall alternate the lead pump position between the three pumps and shall allow the lag pumps to start in response to a rising water level in the pump basin.

2. Pump control panel to utilize a time delay on the start of the lag pumps to prevent all pumps from starting simultaneously,
3. The alternator shall have the capability to allow the operator to manually select which pump(s) to operate.
4. The alternator shall be manufactured by diversified electronics or approved equal. Alternative manufacturers must be approved by the owner.

Q. Control Relay(s)

1. Plug-in control relays with 120-Vac coils shall be provided as required. Contact rating shall be 5-amps (minimum). Sockets shall be of the same manufacture as the relays and hold-down clips shall be furnished to prevent relay from sliding out of the socket.

R. High Wet Well Level Alarm

1. The control panel shall be provided with a suitable alarm circuit, activated by separate level control. This alarm shall signal high-water condition in the wet well. Terminals shall be furnished in the control panel for connection of externally mounted alarm devices. A red flashing light and buzzer/horn shall be provided as visual/audio alarms of the high water in the wet well condition. The float control circuit for the high wet well level alarm shall be normally closed.

S. Liquid Level Controls

1. Mercury float switches
  - a. Normally open float-actuated mercury level control switches shall be provided for:
    - 1) High-level alarm
    - 2) Lag pump on
    - 3) Lead pump on
    - 4) Pumps off
  - b. The mercury switch shall be encapsulated in polyurethane foam for corrosion and shock resistance. Level switches shall be weighted to hold a desired position in the sump. The cord connection to the control shall be numbered 16-2, rated for 13-amps, and shall be type SJTO. To ensure optimum longevity contacts shall be rated for 20-amps at 115-vac and shall be sealed in a heavy-duty glass enclosure. No junction boxes or cable splices of any kind will be allowed in the wet well.
  - c. Float switch body shall be constructed of a Teflon coated, 20-gauge, 304 stainless steel housing measuring not less than 5½-inch in diameter.
  - d. A long life, high reliability, potted SPST magnetic reed switch rated for not less than 100 VA at up to 250 volts shall be mounted inside the float and connected to a multi-stranded, 2 conductors plus ground, 16 gauge, CPE jacketed cable. The cord shall have fine strand conductors (not more than 34 gauge) made especially for heavy flexing service. The cable connection point shall be potted in epoxy providing a strong bond to the float and reed switch forming a water/moisture tight connection. A flexible neoprene sleeve, not less than 1/8-inch thick, shall be provided over the CPE jacketed cable extending not less than 5 inches from the top of the mounting bracket extending down through the cable mounting bracket

hinge point to the top of the float switch body, providing cable stress point relief and extended operational life.

- e. A 304 stainless steel flanged cable mounting clamp assembly shall be supplied allowing pipe or cable mounting as specified below. The float cable mounting bracket shall be flared on both sides providing hinge point stress relief to both sides of the cable.
- f. The float switch assembly shall provide a minimum of two pounds of buoyancy in solutions with a specific gravity of 1.0 (water) and shall have an operating temperature rating of -31° to 194°F.

2. Intrinsically safe barrier

- a. Provide an intrinsically safe barrier between the control panel and lower assemblies. The barrier shall render the level sensing system suitable for use in class I, division I, group d service.

2.25. ALARM DIALER AND TELEMETRY SYSTEM

- A. The pump station shall be provided with an alarm dialer in a lockable NEMA 4X SS enclosure. The dialer shall have a 100-word vocabulary and shall be capable of creating customized messages. The operating environment shall withstand from -50°F to 130°F with a 90% relative humidity, non-condensing. The alarm dialer shall operate on 120-VAC and shall have a rechargeable battery backup capable of providing 4 hours of standby power with surge protectors on the power and telephone lines. The alarm dialer shall monitor the following points:
  - 1. Wet well high-water conditions
  - 2. Manhole high water conditions
  - 3. Pump #1 high temperature
  - 4. Pump #2 high temperature
  - 5. Pump #1 discharge failure
  - 6. Pump #2 discharge failure
  - 7. Pump #1 moisture
  - 8. Pump #2 moisture
  - 9. Pump #1 overload
  - 10. Pump #2 overload
- B. The following alarm conditions shall trigger both the audible and visual alarm.
  - 1. Pump failure
  - 2. High water in the wet well
  - 3. Loss of power supply
- C. Dialer shall have the capability of dialing four phone numbers and shall work on a standard telephone service. The dialer shall be manufactured by Omnisite, ANTX, Inc., or an approved equal. The dialer enclosure shall be equipped with a thermostatically controlled

space heater when it is exposed to the weather. Seal failure and high temperature signals from all pumps shall be combined into a common "pump trouble" alarm to be transmitted from the dialer.

- D. The pump station telemetry units shall be compatible with the Town's current SCADA system. The Town shall not be required to purchase additional software to operate the telemetry unit.

#### 2.26. EQUIPMENT RACK

- A. Pump station monitoring and control equipment shall be located above finished grade for submersible pumps and constructed as shown on the construction plans.

### PART 3 EXECUTION

#### 3.01. INSTALLATION OF PACKAGE PUMP STATION

- A. Prior to installing the pump basin, the contractor shall field locate and obtain approval from the Engineer/Owner.
- B. No less than 27 cubic feet of concrete shall be placed under the base, around the basin anti-floatation flange and over the to the flange to secure the unit and to provide the required resistance to hydrostatic uplift.
  - 1. The site shall be carefully excavated to the required depth, and a bed of no. 67 washed stone, approximately 8-inches thick leveled and compacted. A bed of concrete 2 feet wider than the outside diameter of the pump basin, with a minimum thickness of 8-inches. The basin shall be carefully placed onto the concrete pad. The contractor shall ensure the plumbness of the basin, the basin sits in the middle of the concrete pad and ensure that the cover will be above the surrounding grade as shown on the plans. Insert "J" into the base concrete pad and ensure the hooks are installed as shown on the construction plans. Place a second lift of concrete around the basing to a minimum thickness of 8-inches and ensure complete encapsulation of the basin anti-floatation flange and protruding J-bars.
- C. Final connection to the incoming 4-inch sewer shall not be made until such time as all collection facilities are complete and ready for service.
- D. The contractor shall coordinate the work to minimize inconvenience to the other trades working on the project. Upon completion of the work, the contractor shall dress up and re-seed the disturbed area to the complete satisfaction of the owner.
- E. The contractor shall complete the required electrical connection in accordance with the electrical specifications as presented below.

#### 3.02. ELECTRICAL WORK

- A. The contractor shall provide 208 V, three-phase power service from the facilities' electrical panels to the grinder pumping unit. It is anticipated that the facility will have capacity within the panel(s) to enable the installation of the power circuit to be made to the pump.
- B. The contractor shall verify that space is provided in the existing electrical service for the grinder pump prior to beginning the work and determine if the existing electrical panel can accommodate the additional load.

- C. The contractor shall coordinate all work with the other trades and shall make every effort to perform the work to the complete satisfaction of the owner.
  - D. Regulations and codes
    - 1. All materials and workmanship shall be in accordance with the requirements of the local regulatory authority, the North Carolina Building Code and the National Electric Code, latest edition, as applicable. Work shown or specified more than said codes shall be performed as indicated on the drawings or in the specifications. Work not explicitly detailed on the drawings and in the specifications shall be made to conform to minimum code standards at no additional expense to the owner.
- 3.03. OPERATION AND MAINTENANCE MANUAL
- A. The contractor shall supply three (3) paper copies and two (2) digital copies of complete, written instructions covering the installation, operation, programming, and maintenance of the grinder pumping station equipment. The manuals shall be provided at the time of startup.

END OF SECTION 333216



## SECTION 334200 - STORMWATER CONVEYANCE

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Stormwater drainage piping.
2. Manholes.
3. Catch basins.
4. Cleanouts.
5. Concrete encasement and cradles.
6. Bedding and cover materials.

#### 1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials:

1. AASHTO M36 – Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
2. AASHTO M252 - Standard Specification for Corrugated Polyethylene Drainage Pipe.
3. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications.
4. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 12- to 60-in. Diameter.

B. ASTM International:

1. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
3. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
4. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
5. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

#### 1.3 COORDINATION

A. Section 013000 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with termination of storm sewer connection outside building, trenching, and connection to, municipal sewer utility service.

#### 1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information describing pipe, pipe accessories, and structures.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit special procedures required to install specified products.
- E. Field Quality-Control Submittals: Indicate results of CONTRACTOR-furnished tests and inspections.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of pipe runs, connections, catch basins, cleanouts, and other storm structures. Record rim, invert out and invert in of structures.
- C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work according to standards of authorities having jurisdiction.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience. If work is within the DOT right-of-way, then the manufacturer must be on the DOT approved vendors list.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Provide protection according to manufacturer instructions.

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Ductile-Iron Piping:

1. Pipe:
  - a. Comply with ASTM A746, Class 50, unless indicated otherwise.
  - b. Type: As indicated on Drawings.
  - c. Diameter: As indicated on Drawings.
  - d. Ends: Bell and spigot.
2. Fittings: Ductile iron.
3. Joints:
  - a. Comply with ASTM A746.
  - b. Joint Devices: Rubber gasket.

B. Reinforced Concrete Piping:

1. Pipe:
  - a. Comply with ASTM C76, Class III, unless indicated otherwise.
  - b. Diameter: As indicated on Drawings.
  - c. End Connections: Bell and spigot.
2. Fittings: Reinforced concrete.
3. Joints:
  - a. Comply with ASTM C990 for joints using Preformed Flexible Joint Sealants.
  - b. Comply with ASTM C443 for joints using Rubber Gaskets.
  - c. Gaskets: Rubber, compression.

C. Corrugated PE Piping:

1. Pipe:
  - a. Comply with AASHTO M252 and M294, as applicable.
  - b. Type: Smooth Interior as indicated on Drawings.

- c. Diameter: As indicated on Drawings.
  - 2. Fittings: PE.
  - 3. Joints: Comply with AASHTO M252, and AASHTO M294 as applicable.
- D. Corrugated Steel Piping:
- 1. Pipe and Fittings:
    - a. Comply with AASHTO M36.
    - b. Nominal Diameter: As indicated on the Drawings.
    - c. Coating: Inside and outside, as indicated on Drawings.
  - 2. Fittings: Corrugated steel.
  - 3. Coupling Bands:
    - a. Material: Galvanized steel.
    - b. Minimum Size: 0.052 inch thick by 10 inches wide.
    - c. Connection: Two neoprene O-ring gaskets and two galvanized-steel bolts.
- E. PVC Piping:
- 1. Pipe:
    - a. Comply with ASTM D3034, SDR 35.
    - b. Inside Nominal Diameter: As indicated on the Drawings
    - c. Style: Bell and spigot with rubber-ring sealed gasket joint.
  - 2. Fittings: PVC.
  - 3. Joints:
    - a. Comply with ASTM F477.
    - b. Gaskets: Elastomeric.

## 2.2 MANHOLES

- A. As specified in Section 330561 – Concrete Manholes.

## 2.3 CATCH BASINS, DROP INLETS, JUNCTION BOXES, YARD INLETS

- A. Shaft and Top Section:
  - 1. Furnish materials according to Drawings and authorities having jurisdiction.
- B. Lids and Frames:
  - 1. Furnish materials according to Drawings and authorities having jurisdiction.

## 2.4 CONCRETE ENCASEMENT AND CRADLES

- A. Concrete:

1. Description: concrete, as specified in Section 033000 - Cast-in-Place Concrete.
2. Compressive Strength: 3,000 psi at 28 days, unless otherwise indicated, concrete, rough troweled finish.

## 2.5 MATERIALS

- A. Bedding and Cover: As indicated on Drawings, Specifications and in accordance with authorities having jurisdiction.

## 2.6 ACCESSORIES

- A. Geotextile Filter Fabric:
  1. Comply with AASHTO M288 for subsurface drainage.
  2. Type: Class and type as indicated on Drawings.
- B. Underground Pipe Markers: In accordance with authorities having jurisdiction.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

### 3.2 PREPARATION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Correct over-excavation with bedding material as indicated on Drawings.
- C. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

### 3.3 INSTALLATION

- A. Excavation and Bedding:
  1. Excavate trench to depth indicated on Drawings below pipe invert, and as specified in Section 312316.13 - Trenching.
  2. Hand trim excavation for accurate placement of piping to indicated elevations.

3. Place bedding material at trench bottom.
4. Level materials in continuous layers as specified in Section 312316.13 - Trenching.
5. Maintain optimum moisture content of bedding material to attain required compaction density.
6. Place geotextile fabric over compacted bedding, as indicated on Drawings.

B. Piping:

1. Pipe, Fittings, and Accessories: Comply with ASTM D2321.
2. Seal joints watertight.
3. Place pipe on bedding as indicated on Drawings and in accordance with authorities having jurisdiction.
4. Cradle bottom of pipe diameter to avoid point load as indicated on Drawings.
5. Backfilling and Compaction:
  - a. As indicated on Drawings, as specified in Section 312323 - Fill and in accordance with authorities having jurisdiction.
  - b. Do not displace or damage pipe while compacting.
6. Manholes: As specified in Section 330561 - Concrete Manholes.
7. Pipe Markers: In accordance with authorities having jurisdiction.
8. Install Site storm drainage system piping to within 5' feet of building.
9. Installation Standards: Install Work according to authorities having jurisdiction standards.

C. Catch Basins and Cleanouts:

1. Installation Standards: Install Work according to the authority having jurisdiction.

3.4 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Indicated Pipe Slope: 1/8 inch in 10 feet.

3.5 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Request inspection by ENGINEER prior to and immediately after placing aggregate cover over pipe.
- D. Testing:
  1. Compaction Test:
    - a. Comply with recommendations of Geotechnical Engineer.

- b. Testing Frequency: As required by Geotechnical Engineer and authorities having jurisdiction.
- 2. Manholes: As specified in Section 330561 - Concrete Manholes.
- 3. Piping: Inspect pipe for rips, tears, joint separations, soil migration, cracks, localized buckling, settlement, alignment, and deflection.
- 4. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

### 3.6 PROTECTION

- A. Section 017000 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 334200





## SECTION 335015 - INTERIOR CORROSION PROTECTION FOR DUCTILE IRON PIPE

### PART 1 GENERAL

#### 1.01. THE REQUIREMENT

- A. Ductile iron pipe and fittings requiring an interior coating of ceramic epoxy for corrosion protection shall be furnished with an approved amine cured novolac epoxy coating. Acceptable coatings include Series 431 Perma Shield PL as manufactured by Tnemec, Protecto 401 as manufactured by Induron, Permox CTF as manufactured by Permite, or approved equal.

### PART 2 PRODUCTS

#### 2.01. LINING

- A. The ceramic epoxy shall be an amine cured novolac epoxy containing at least 20% by volume of ceramic quartz pigment. The lining material shall comply with the following properties:
  - 1. A permeability rating of 0.00 when tested according to the procedure described in Method A of ASTM E96, Procedure A with a test duration of 30 days.
  - 2. The following test must be run on coupons from factory lined ductile iron pipe.
    - a. ASTM B 117 Salt Spray (scribed panel) - Results to equal 0.0 undercutting after two years
  - 3. ASTM G95 Cathodic Disbondment (1.5 volts@ 77° F) - Results to equal no more than 0.5mm under-cutting after 30 days
  - 4. Immersion Testing rated using ASTMD714
    - a. 20% Sulfuric Acid - No effect after two years
    - b. 140° F - 25% Sodium Hydroxide - No effect after two years
    - c. 160° F Distilled Water - No effect after two years
    - d. 120° F Tap Water (scribed panel) - 0.0 undercutting after two years with no effect.
  - 5. Abrasion Resistance
    - a. Less than 4 mils loss after one million cycles on a +22.5° sliding aggregate slurry abrasion tester using a sharp natural siliceous gravel with a particle size between 2 and 10mm.

### PART 3 EXECUTION

#### 3.01. APPLICATOR

- A. The lining shall be applied by a competent firm, who has been certified acceptable by the manufacturer with a successful history of applying linings to the interior of ductile iron pipe and fittings.

#### 3.02. SURFACE PREPARATION

- A. Prior to abrasive blasting, the entire area to receive the protective compound shall be inspected for oil, grease, etc. Any areas where oil or grease is present, or any substance which can be removed by solvent, shall be solvent cleaned using the guidelines outlined in DIPRA-1 Solvent Cleaning. After the surface has been made free of grease, oil or other substances, all areas to receive the protective compounds shall be abrasive blasted using compressed air nozzles with sand or grit abrasive media. The entire surface to be lined shall be struck with the blast media so that all rust, loose oxides, etc., are removed from the surface. Only slight stains and tightly adhering annealing oxide may be left on the surface. Any area where rust reappears before lining must be re-blasted. Abrasive blasting of previously lined pipe or fitting (including cement lined materials) is not acceptable. Only virgin metal materials will be utilized in the lining process.

3.03. LINING

- A. Within 8 hours of surface preparation, the interior of the pipe shall receive 40 mils (minimum), normal dry film thickness of the approved lining. No lining shall be applied when the substrate or ambient temperature is below 40° F. The surface also must be dry and dust free. If flange pipe or fittings are included in the project, the lining shall not be used on the face of the flange.

3.04. NUMBER OF COATS

- A. The number of coats of lining material applied shall be as recommended by the lining manufacturer. However, in no case shall this material be applied above the dry thickness per coat recommended by the lining manufacturer in printed literature. The maximum or minimum time between coats shall be that time recommended by the lining material manufacturer. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

3.05. TOUCH-UP & REPAIR

- A. Joint Compound shall be used for touch-up or repair in accordance with liner manufacturer's recommendations.

3.06. INSPECTION AND CERTIFICATION

- A. Ductile iron pipe and fitting linings shall be checked for thickness using a magnetic film thickness gauge. The thickness testing shall be done using the method outlined in SSPCPA-2 Film Thickness Rating.
- B. The interior lining of all pipe and fittings shall be tested for pinholes with a nondestructive 2,500-volt test. Any defects found shall be repaired.
- C. Each pipe joint and fitting shall be marked with the date of application of the lining system along with its numerical sequence of application on that date and records maintained by the applicator of his work.

3.07. HANDLING (AT THE FACTORY AND IN THE FIELD)

- A. The lined Pipe and Fittings must be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying. If damaged, the material shall be repaired in accordance with the liner manufacturer's recommendations.

3.08. WARRANTY

- A. A one (1) year warranty shall be furnished by the manufacturer on the serviceability of the lining. This warranty shall include but not be limited to, statements that at any time up to the end of the year from the date of project acceptance:
1. The lining shall not have disbanded.
  2. The lining shall not have suffered any appreciable underfilm migration.
  3. The interior pipe metal, at points of pinholes or holidays, shall not have suffered detrimental deterioration.
  4. The lining shall have maintained its smooth surface characteristics. The CONTRACTOR and/or manufacturer shall not make any exemption or exception to the above stated conditions or warranty within the limits as stated in this section of these specifications.

END OF SECTION 335015



## SECTION 412200 - DAVIT CRANE

### PART 1 GENERAL

#### 1.01. SUMMARY

- A. The work required under this section shall include the designing, manufacturing, shipping, installing and field testing of a portable davit crane and wire rope hoist.
- B. On-site training of operators will be provided by the manufacturer. This will include but not necessarily be limited to:
  - 1. Techniques of safe operation,
  - 2. Daily and monthly inspections,
  - 3. Minor troubleshooting

#### 1.02. SUBMITTALS

- A. Shop Drawings
  - 1. Submit for approval, Shop Drawings showing complete details, dimensions, field coordinates and bills of material for fabrication and erection.
  - 2. Drawings shall be "Stamped" by a Professional Engineer, duly licensed in the State of North Carolina.
  - 3. Include member sizes, model numbers, specifications, reactions and complete shop and field notes such as welding symbols, paint requirements, bolt sizes, etc.
  - 4. Submit complete calculations for member sizes, design criteria and seismic calculations stamped as per 2 above.
  - 5. The shop drawing shall indicate the lowering and lifting load limits of the hoist and crane.
- B. Product Data
  - 1. Provide information on all components, sub-assemblies, control systems, mechanical features, etc. relating to the equipment supplied under this specification.
  - 2. Include brochures, catalog cuts, parts breakdowns, operation and maintenance manuals, clearance diagrams, dimensional data (not supplied in the shop drawings) and any other data necessary for the engineer to determine compliance with specifications.

#### 1.03. QUALITY ASSURANCE

- A. Manufacturer shall be registered ISO 9001:2000 compliant with an independent certification agency approved by the International Organization for Standardization.
- B. Manufacturer shall have documented experience of ten (10) years, having successfully designed and built installations of similar scope.
- C. Contractor shall be responsible for providing equipment of highest quality and workmanship which will perform specific functions reliably and safely and allow required maintenance procedures with a minimum amount of interference to operation of the equipment.

- D. A copy of the Manufacturer's Quality Assurance Plan shall be made available to customer for review prior to award.
  - E. Equipment not meeting all requirements of this specification will be replaced with compliant components at no additional cost to the owner.
- 1.04. DELIVERY, STORAGE AND HANDLING
- A. Unloading and storage of crane shall be as required by the Manufacturer.

## PART 2 PRODUCTS

### 2.01. DAVIT CRANE

- A. Davit crane shall be as manufactured by Thern, Inc., Commander 1000, Model 5PT10-M2 or approved equal.
- B. The davit crane shall be designed with an ultimate design factor greater than 3:1 for all components including the lifting winch and base.
- C. The davit crane shall have a variable lift capacity based on boom length, to vary between 1,200 pounds lift capacity with the boom in the shortest length, and 550 pounds with the boom fully extended.
- D. The boom of the crane shall telescope up to 4 different lengths allowing a maximum hook reach of at least 66 inches measured from mast center to hook center.
- E. Hook height shall be adjustable by moving the boom up or down between 5 degrees above horizontal and 45 degrees from vertical, with a minimum of 44 inches between the lowest position and the highest position with the boom fully extended.
- F. Boom angle shall be adjustable at all times, with a hand operated screw jack acting to raise or lower the boom between 5 degrees above horizontal and 45 degrees from vertical.
- G. The wire rope for the davit crane shall pass over a sheave at the end of the boom. Sheave shall have a bronze bearing.
- H. The minimum height clearance of the boom shall be 36 inches between mounting surface and the underside of the boom in all base configurations.
- I. The mast and boom shall rotate 360 degrees in the base on pin bearing and bearing sleeve, with a rotational handle attached to mast to facilitate rotation.
- J. The crane components shall be fastened together using stainless steel clevis style pins, secured with lynch pins with lanyards fastening the lynch pins to primary structural components.
- K. The davit crane shall break down into portable components with no single component weighing more than 100 pounds. Carrying handles shall be welded to mast and boom.
- L. The lifting winches shall be located such that the center point of the drive shaft is behind the centerline of the mast.
- M. The davit crane shall be labeled with a non-corrosive metal identification plate labeled or imprinted with the manufacturer's name, model number, serial number, capacity rating and other essential information.

### 2.02. CRANE BASE

- A. The crane base shall be as the same manufacturer of the crane.
- B. The crane base shall allow for removal of the mast.
- C. The crane base shall have a pin bearing to support the end of the mast and a Nyloil MDX bearing sleeve to support the mast at the top of the base.

2.03. CRANE AND BASE FINISH

- A. The crane boom, mast and base shall be fabricated from steel meeting ASTM standards.
- B. The crane boom, mast and base shall have a corrosion resistant power coating finish.

2.04. LIFTING WINCH

- A. Winch shall have machine cut worm gears operating in an enclosed oil bath, cast aluminum gear case and drum construction, an adjustable handle that mounts securely to the drive shaft for manual operation, bronze and radial ball bearings, pressure plate, and a positive load holding mechanical brake able to stop and hold the load automatically if the winch handle is released.
  - 1. Winch shall be as manufactured by Thern, Inc., Series M2 or approved equal.
- B. The lifting winch shall include a quick disconnect feature allowing quick attachment and detachment of wire rope equipped with a swaged ball anchor.
- C. The lifting winch shall be equipped with a hex drive input to allow drill drive operation with a maximum rated drill speed of 400 rpm, drill not included.

2.05. WIRE ROPE

- A. The wire rope construction shall be 7 x 19 type 304 stainless steel cable, minimum.
- B. Latch type hooks shall be used and shall be either non-rotating eye type or swivel type to allow 360-degree rotation under all load conditions. Hooks shall be heat treated drop forged type 304/316 stainless steel.

PART 3 EXECUTION

3.01. CRANE ERECTION

- A. The crane supplier shall receive, unload, and erect the cranes in accordance with applicable codes and specifications.
- B. Installers shall be employees of the supplier and have a minimum of five (5) years of experience installing davit cranes.

3.02. FIELD QUALITY CONTROL

- A. Acceptance Test
  - 1. Conduct testing for final acceptance after the erection work has advanced to the point that inspection and testing can proceed without interruption.
  - 2. Allow inspection of all parts of the crane containing electrical parts or moving mechanical parts by the Engineer.
  - 3. Test the cranes for capacity, speed, and deflections in the presence of the Engineer and owner with 125 percent of the hoist capacity load on the hook.

4. Test weights shall be supplied by crane supplier.
5. Crane supplier will transmit to the owner a certificate of load test and compliance with OSHA requirements.

3.03. TRAINING

- A. Following the acceptance testing, the crane supplier will provide up to 4-hours of instruction and field training of operators.
- B. The instruction will include but not necessarily be limited to techniques of safe operation, daily and monthly inspections, minor troubleshooting.
- C. The field training will consist of having the operators actually operate the crane and perform a daily inspection.
- D. A written exam will be conducted to insure the operator's understanding and compliance with the required codes of conduct.

END OF SECTION 412200



## SECTION 3.0

### DESIGN CONSIDERATIONS FOR WATER SYSTEM EXTENSIONS

#### 3.1 GENERAL

The intent of this section is to provide the Developer or Engineer with Guidelines which will assist in the development of Contract Documents for water system extensions for which acceptance by the Town will be sought. As a minimum, the Contract Documents for any proposed extension must address satisfactorily the topics contained herein.

#### 3.2 LOCATION AND ALIGNMENT

##### 3.2.1 Depth of Cover

Water mains shall be designed to provide a cover of no less than three feet (3') but no more than five feet (5') as measured from the top (crown) of the pipe to the finished grade. Where this requirement cannot be met due to unavoidable conflicts in grade, the Department Engineer shall be consulted so that a solution acceptable to the Town may be determined. If, in the opinion of the Department Engineer, conditions warrant greater or lesser depths of cover than that required above, special measures, such as the use of ductile iron pipe for shallow installations, or additional easement widths for deeper installations may be required by the Town. In shallow installations, the water main shall be buried to sufficient depth to provide a minimum of 30 inches of cover.

##### 3.2.2 Relationship of Mains to Property Lines, Rights-of-Way and Structures

All water mains shall be located within dedicated street rights-of-way or permanent water main easements such that the Town's maintenance and repair forces have unrestricted access to the line and all appurtenances thereof.

3.2.2.1 Water mains shall be centered in a permanent easement of adequate width to allow excavation and maintenance of the line. In no case shall the permanent easement for water mains be narrower than that given by the table below.

Pipe Diameter	Minimum Easement
Less than 12"	10'
12" - 24"	15'
Greater than 24"	20'

3.2.2.2 Under certain conditions Director may require such additional easement as deemed appropriate. Such easement shall be centered on the water main unless directed otherwise by the Town.

3.2.2.3 Approval of water main extension plans shall be contingent upon the procurement of all easements necessary to meet the above requirements

and upon the execution of an encroachment agreement with the owner of each right-of-way which the proposed main will cross. See Section 8.7 for the requirements for submission of easement documents.

- 3.2.2.4 Water mains shall be located no closer than ten feet (10') horizontally to buildings or substantial surface structures.

### 3.2.3 Relationship of Water Mains to Sanitary Sewers

- 3.2.3.1 Water mains shall be laid at least ten feet (10') laterally from existing or proposed sewers, unless local conditions or barriers prevent a ten foot (10') lateral separation, in which case:

- 3.2.3.1.1 The water main is laid in a separate trench with the elevation of the bottom of the water main at least eighteen inches (18") above the top of the sewer; or

- 3.2.3.1.2 The water main is laid in the same trench as the sewer with the water main located at one side on a bench of undisturbed earth, and with the elevation of the bottom of the water main at least eighteen inches (18") above the top of the sewer.

- 3.2.3.2 Whenever it is necessary for a water main to cross over a sewer, the water main shall be laid at such an elevation that the bottom of the water main is at least eighteen inches (18") above the top of the sewer, unless local conditions or barriers prevent an eighteen inch (18") vertical separation; in which case both the water main and the sewer shall be constructed of ferrous materials and with joints which are equivalent to water main standards for a distance of ten feet (10') on each side of the point of crossing.

- 3.2.3.3 Whenever it is necessary for a water main to cross under a sewer, both the water main and the sewer shall be constructed of ferrous materials for a distance of ten feet (10') on each side of the point of crossing. A section of water main pipe shall be centered over the crossing.

### 3.2.4 Relationship of Water Mains to Storm Sewers

When underground structures or storm sewers are encountered, eighteen inches (18") minimum vertical separation and five feet (5') minimum lateral separation shall be maintained. Water main and storm sewer crossings shall be constructed in accordance with the Standard Details.

### 3.2.5 Location Under Paved Areas

Water mains shall be located outside of proposed or existing paved areas except where required at intersections, cul-de-sacs, street crossings by water mains, other paved areas which must be crossed, or where structures or other obstacles make

this impossible. When a new water main must be located under an existing or proposed paved area it shall have a minimum cover of three feet (3') as measured from the top of the pipe to the finished subgrade. Water mains proposed within paved areas should be designed to avoid parking spaces whenever possible. Water mains located in cul-de-sacs should be projected straight through, and the main should terminate at the property corner with the hydrant and auto flushing device located on the property corner/right-of-way. If design of the cul-de-sac does not allow this, a 90° bend should be used to direct the main to a property corner, thereby allowing water services to be installed in accordance with Section 3.2.9.

### 3.2.6 Location of Fire Hydrants

- 3.2.6.1 Fire hydrants shall be installed with the back of the hydrant being located on the right-of-way limit with preference being given to street intersections. In no case shall any portion of a hydrant be closer than five feet (5') from the back of the curb or two and one-half feet (2.5') to the backslope of a roadside ditch.
- 3.2.6.2 Hydrants shall be oriented so that the pumper nozzle faces the roadway and so that the nozzle centerline is a minimum of eighteen inches (18") and a maximum of twenty-four inches (24") above finished grade. See Standard Details.
- 3.2.6.3 All structures and subdivisions whether residential or not shall be located such that each structure or portion thereof will be within five hundred feet (500') of a hydrant. This determination shall be made via vehicle access routes (roadways, fire lanes, etc.) and by hose placement from the fire fighting equipment in lieu of linear measurements. Fire hydrants shall be placed approximately 500' apart.
- 3.2.6.4 For any structure that has a fire sprinkler system or a standpipe system, a fire hydrant shall be no more than 100' from the fire department connection. This hydrant shall be dedicated to the fire department connection and shall be in addition to the hydrants required by Section 3.2.6.3. The hydrant shall be located on the supply side of the backflow prevention device.
- 3.2.6.5 Where possible, fire hydrants shall be located a minimum of fifty feet (50') from any structure.
- 3.2.6.6 For proposed subdivisions where the location of structures is not known, hydrant spacing shall be measured along the street right-of-way with spacing provided as shown in 3.2.6.3 above. Measurements across will not be permitted for purposes of satisfying hydrant spacing requirements.
- 3.2.6.7 Structures located on multi-lane streets or highways shall require fire hydrants located on the same side of the roadway as the structure. Multi-lane shall be defined as a street, highway, avenue, road or

thoroughfare having four (4) or more lanes including the center turn lane. Fire hydrant locations shall be staggered in relation to opposite sides of the street or roadway.

3.2.6.8 In the case of a water main extension along streets with four (4) or more lanes, fire hydrants shall be required to be staggered opposite sides of the street or roadway in accordance with Section 3.2.6.3 above.

3.2.6.9 Dead end mains shall be provided with a hydrant and auto flushing device required by Section 3.2.10 of the Manual.

3.2.6.10 Each phase of a project shall be designed and constructed to provide the minimum number of hydrants necessary to conform with this Section upon completion of the phase.

### 3.2.7 Location of Gate Valves

3.2.7.1 Each intersection of water mains shall have one less main valve than the number of intersecting pipes, i.e. crosses shall have three (3) main line valves, a tee intersection shall have two (2) main line valves. Valves shall not be located in the curb and gutter or in a ditch.

3.2.7.2 A proposed connection of a new water line to an existing water line shall include provisions for the addition of sufficient valves to the existing water line to meet the intent of Paragraph 3.2.7.1. If there are existing valves located in close proximity to the proposed connection, the Town will not require that valves be added to the existing water line except in unusual circumstances.

3.2.7.3 Each fire hydrant shall have a hydrant branch valve in accordance with the Standard Details. Valves box on a hydrant branch shall not be located in curb and gutter.

3.2.7.4 In addition to the valves required at tees, crosses, hydrants, etc., in-line valves shall be provided at intervals no greater than 1,500 feet unless otherwise approved by the Town because of unusual circumstances.

3.2.7.5 Valve boxes shall be installed on all valves in accordance with Section 3.4.10 of this Manual and as shown in the Standard Details.

### 3.2.8 Location of Air Release Valves

3.2.8.1 Mains twelve inches (12") or larger in diameter, which have a change in elevation of fifteen feet (15') or greater, shall have an air release valve meeting the requirements of Section 10.8 of the Manual installed at the highest elevation of such change.

- 3.2.8.2 The Town may also require air release valves in other instances where, in the opinion of the Department Engineer, the possibility of excess quantities of air accumulating in the proposed main exists.
- 3.2.8.3 See the Standard Details and Section 10.8 for requirements of the Town regarding taps for air release valves.
- 3.2.8.4 Manual air release valves shall be installed in a standard meter box. Automatic air release valves shall be provided with a standard manhole.

3.2.9 Location of Services

- 3.2.9.1 Plans for projects which propose the creation of lots shall include the provision of water services to each lot, including any residual parcels and areas reserved for future lots. The size and location of services shall be based upon the anticipated use of the lot and require the Town's approval. The Town may agree to waive its requirement that water services be installed to each lot within non-residential subdivisions if there is insufficient information available to permit proper sizing of services and they can be conveniently installed by the Town at the time service is requested.
- 3.2.9.2 Town of Beaufort reserves the right to require individual water and sewer services to each building or tenant space.
- 3.2.9.3 Water meter boxes shall be set flush with the finished grade and located on the street right-of-way limit at the center of the lot for which service is installed, unless directed otherwise by the Town or this Manual. The box shall be located five (5) feet from the new sewer cleanout on the right-of-way limit.
- 3.2.9.4 When project design dictates that electric cables are to be placed on the same side of the roadway with the sidewalk, the water meter box for that side shall be located six feet behind the edge of the sidewalk.
- 3.2.9.5 Water meter boxes shall not be located within driveways, sidewalks, or other paved areas subject to vehicular traffic unless approved otherwise by the Town.
- 3.2.9.6 Water meter boxes shall not be installed within a ditch slope. Where the right-of-way limit for a street is within a ditch slope, the meter box shall be installed a minimum of 2.5 feet behind the top of the ditch bank.
- 3.2.9.7 Easement shall be provided for all water meter boxes not located in existing rights-of-way or easement.
- 3.2.9.8 Water services shall be located perpendicular to the main.

3.2.9.9 Plans should not propose the crossings of public and private utilities.

3.2.10 Location of Blow-Offs and Dead End Hydrants

3.2.10.1 Dead ends on mains six inches (6") in diameter or larger shall be provided with a standard fire hydrant and an auto flushing device at the terminal end. Materials and installation shall be as required by the Town for standard fire hydrants.

3.2.10.2 Dead ends on mains four inches (4") and smaller in diameter shall be provided with an auto flushing device meeting the requirements of Section 10.4.2.2 of the Manual and the Standard Details.

3.2.10.3 All water lines shall be terminated in accordance with the Standard Details with blow-offs and hydrants located on property corners whenever possible.

3.2.11 Location Of Backflow Prevention Assemblies

The location of backflow prevention assemblies shall be in accordance with the requirements of the State Cross Connection Standards.

3.2.11.1 In general, all backflow prevention assemblies shall be located outside of the structure and before any branch connections to the private system, with preference being given to the property line/right of way, unless otherwise approved by the Town.

3.2.11.2 Backflow assemblies shall be required for any application in which possible pollution or contamination of the public water supply system could result from a backflow cross-connection.

3.2.11.3 In accordance with the Terms and Conditions and the Rules Governing Public Water Supply Systems, the severity of the potential effects shall determine the minimum degree of protection required. The Town will review each case on an individual basis.

**3.3 SIZING OF WATER MAINS**

3.3.1 General

Water mains are to be sized in accordance with this Manual and good engineering practice. The standards included herein are minimum standards. The Engineer shall design the water distribution system based upon the available supply and the project needs.

3.3.2 Pressure Requirements

Water mains shall be sized so that a minimum residual pressure of 20 psi is obtained during peak demand plus fire flow. Where higher pressures are required,

it shall be the responsibility of the individual property owner to provide the necessary booster pumping facilities.

### 3.3.3 Fire Hydrants

All fire hydrants shall be installed on a six-inch (6") leg with a six-inch (6") hydrant branch valve.

### 3.3.4 Private Mains Fire Lines

Private mains shall be sized by the Engineer in accordance with Section 3.3.5 of this Manual. Backflow prevention shall be provided in accordance with Section 3.2.11 of this Manual. Private fire lines for all land uses shall be provided with a backflow prevention device in accordance with the Terms and Conditions, Section 16 and 18 included in Appendix A of this Manual.

### 3.3.5 Minimum Fire Flows

#### 3.3.5.1 General

Unless otherwise required or permitted by the Town, water distribution systems shall be designed to provide the fire flow required by the guidelines contained in this Section. The Town's existing facilities may or may not be adequate to provide the required fire flow at the time of design and construction of the planned development; however, the Town shall provide the Engineer with an estimated value for the system pressure at design fire flow available at the point where the planned development is to connect with the Town's existing distribution system. This value may be based upon the actual system pressure available or calculation of the pressure which shall be available upon reinforcement of the existing system. The Developer or his Engineer shall provide the Town with the value (subject to approval) of the design fire flow necessary to meet the requirements of this Section.

The value for design fire flow and supporting documentation shall be submitted with the preapplication package should the Town require the submission of such a package (See Section 2.3). The design fire flow and supporting documentation shall also be submitted for approval with the design calculations as required by Section 8.

#### 3.3.5.2 Fire Flow Conditions

Selection of the size of the water main for fire flow capacity shall be such that the main will deliver the discharge required by Section 3.3.5.3 or Section 3.3.5.4, as applicable, including the peak user demand of the development. A minimum residual pressure of 20 psi shall be available at all points of the planned distribution system at fire flow plus peak user demand.

### 3.3.5.3 Fire Flow for Residential Areas

The following guideline shall apply to all residential developments including single family dwellings, duplexes, and multi-family dwellings.

Guidelines for determining peak user demand as published in the North Carolina Administrative Code, Title 15A, Subchapter 18C are included in this Manual as Appendix A.

3.3.5.3.1 Where buildings are separated by less than ten feet (10') between exterior walls, the minimum draft available to any hydrant serving the development shall be 1500 gallons per minute (gpm) plus peak user demand with a minimum residual pressure of 20 psi.

3.3.5.3.2 Where buildings are separated by ten feet (10') or more between exterior walls, the minimum draft available to any hydrant serving the development shall be 1000 gpm plus peak user demand with a minimum residual pressure of 20 psi.

### 3.3.5.4 Commercial Areas

Fire flows in areas other than residential are dependent upon the type of construction, the total floor area of the buildings and other factors within a project. In order to provide an adequate design, developers of non-residential property should consult with the appropriate insurance carrier for required design criteria.

As a minimum, the recommendation of the Insurance Services Office shall be met. These recommendations include the following for commercial developments.

- a. The minimum size main shall be 8-inch with 8-inch or larger intersecting mains in each street; 12-inch or larger mains shall be used on the principal streets and for all long lines that are not connected to other mains at intervals close enough for mutual support.
- b. Arrangements using very small mains, designed for domestic service only and incapable of providing fire protection supplied by larger mains in a gridiron too wide to provide good fire protection are considered unsatisfactory. The use of dead end 6-inch and smaller mains to provide fire protection shall be avoided.



Guidelines for determining needed fire flow as published in the Insurance Services Office Fire Suppression Rating Schedule are included in this Manual as Appendix A.

### **3.4 INSTALLATION OF WATER MAINS AND APPURTENANCES**

#### **3.4.1 General**

The Contract Documents for water system extensions shall insure that the following standards and performance requirements are met in regard to the installation of mains and all appurtenances thereof.

#### **3.4.2 Construction Safety**

The Contract Documents shall address the responsibility for the safety of the workmen and the general public. The Contractor shall be required to adhere to the requirements of the NCDOT with regard to traffic safety and traffic control devices. The Town adopts by reference the safety requirements of the NCDOT manual of uniform traffic control with NC Supplement for all construction activity on Town streets. Additionally, the Contractor shall be required to perform all work in accordance with all applicable federal, state, and local laws. The Contract Documents shall state that the Town has neither responsibility for nor authority to enforce job safety requirements. 6.22 and 6.23 of The "Standard General Conditions of the Construction Contract" prepared by the Engineers Joint Contract Documents Committee shall be used as a guideline for preparation of the Contract Documents.

#### **3.4.3 Replacement of Damaged Facilities and Structures**

The Engineer shall insure, through the Contract Documents, that all structures, pavements, utilities and other facilities which may be damaged as a result of project work are replaced or repaired in a manner which meets the approval of the owner of such facilities or any governing bodies having jurisdiction.

#### **3.4.4 Connection to Town Owned Facilities**

Language shall be included in the Contract Documents which states that no connection to or alteration (including operation of valves, hydrants, etc.) of the Town's facilities shall be performed without the Town's specific approval. The Contract Documents shall require that all pipe, valves, taps, fittings, etc., which could possibly contaminate the Town's facilities be thoroughly disinfected prior to their use. The Contract Documents shall also include a requirement to keep excavations for such connections completely dewatered and to use the utmost care to avoid contamination of Town owned facilities.

#### **3.4.5 Salvage of Town Owned Facilities**

When project work results in removal of Town owned facilities and equipment, the Contractor shall be required to deliver those facilities or equipment undamaged

to the Town's Operations Center on Hedrick Street, if requested to do so by the Town.

#### 3.4.6 Water Main Construction and Excavation

3.4.6.1 Pipe installation shall be performed only in the presence of the Town's Representative, except as authorized by the Town.

3.4.6.2 The Contract Documents shall specifically address excavation, pipe foundation and bedding, pipe installation and haunching requirements. Satisfactory construction materials shall be identified and either construction methods or performance standards shall be specified. If standard references are cited in lieu of specific requirements, the Engineer shall furnish the Town, at no cost, two (2) copies of the cited references, if requested to do so.

3.4.6.3 No deviation from the line and grade shown on the Approved Plans shall be permitted by the Contract Documents without the approval of the Town. Any proposed deviation will require submission of revised Contract Documents to the Town for review and approval.

3.4.6.4 Pipe cutting, where necessary and where permitted, shall be done in accordance with the written recommendations of the pipe manufacturer.

3.4.6.5 The Engineer shall require fittings at sufficient locations to minimize the possibility that pipe joint deflections will exceed the maximum horizontal or vertical joint deflections recommended by the pipe manufacturer. Unless the Engineer requires the use of a specific manufacturer's pipe, he shall assume, for design purposes that the allowable deflection is the minimum found in the industry. Layout of plastic pipe larger than six inches (6") in diameter shall be based upon the assumption that no deflection can be accomplished by bending the pipe barrel.

3.4.6.5.1 Longitudinal deflection for six-inch (6") diameter and smaller AWWA C900 pipe shall be such that the minimum bending radius (Rb) of the deflected pipe center is equal to or greater than the value obtained by use of the following relationship.  $R_b = 300 \times D_j$  where Rb is the minimum bending radius in feet and D is the nominal pipe inside diameter in feet. Longitudinal bending of PVC pipe affected through mechanical means will not be allowed.

3.4.6.5.2 Longitudinal deflections for ductile iron pipe shall not exceed the values given in ANSI/AWWA Standard C600 which are as follows:

MAXIMUM LONGITUDINAL DEFLECTIONS FOR DUCTILE IRON PIPE						
	TYPE OF JOINT					
	PUSH-ON			MECHANICAL JOINT		
NOMINAL PIPE SIZE (INCHES)	DEFLECTION ANGLE (DEGREES)	MAXIMUM OFFSET (INCHES)		DEFLECTION ANGLE (DEG-MIN)	MAXIMUM DEFLECTION JOINT (INCHES)	
		18 Ft. Joint	20 Ft. Joint		18 Ft. Joint	20 Ft. Joint
4	5	19	21	8-18	31	35
6	5	19	21	7-7	27	30
8	5	19	21	5-21	20	22
10	5	19	21	5-21	20	22
12	5	19	21	5-21	20	22

14	3*	11	12	3-35	13.5	15
16	3*	11	12	3-35	13.5	15
18	3*	11	12	3-0	11	12
20	3*	11	12	3-0	11	12
24	3*	11	12	2-23	9	10
30	3*	11	12			
36	3*	11	12			
42	3*	11	12			
48	3*	11	12			
54	3*	11	12			

\*For 14-in. and larger push-on joints, maximum deflection angle may be larger than shown above. Consult the manufacturer.

- 3.4.6.6 The Contract Documents shall require the Contractor to prevent surface water from accumulating in the trenches. Trenches shall be free of water during pipe installation.
- 3.4.6.7 The Contract Documents shall require trench excavation to provide vertical curve chords which will not exceed the permissible deflection of the pipe. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each joint of pipe on undisturbed soil at every point along its entire length.
- 3.4.6.8 The Contract Documents shall provide for the placement of select fill in the bottom of the trenches when unstable material is encountered. Such unstable material shall be removed to the depth required by the Town and replaced with suitable backfill such that the pipe will be adequately supported throughout its entire length.
- 3.4.6.9 The Contract Documents shall require thrust blocking at each horizontal and vertical change in direction of a main. Trenches shall be excavated to provide uniform support of the blocking on undisturbed soil. The concrete shall be placed as shown in the Standard Details and shall not interfere with the removal of any bolts, fasteners, or fittings. Ductile iron fittings shall be wrapped in polyethylene prior to placement of the concrete blocking.

- 3.4.6.9.1 In lieu of concrete thrust blocking, piping systems 12 inches and smaller in diameter may be restrained through the use of restrained joint pipe or approved joint restraint devices meeting the requirements of Section 10.2.6. The minimum length of piping to be restrained shall be as set forth in the table below.

*Restrained Length (ft.)					
Pipe Size (in.)	4	6	8	10	12
Pipe Cover (ft.)					
3.0	16	24	31	38	46
4.0	15	23	30	37	43
5.0	14	22	29	36	42

\* Above values are the lengths of restrained pipe required on each side of fitting. Above values are for 45° horizontal bend. For other horizontal bends multiply above by the following coefficients: 90° - 2.4; 22 1/2° - 0.48; 11 1/4° - 0.24; tee and dead end - 2.4.

The use of joint restraint devices on vertical bends and on piping systems larger than 12 inches in diameter shall not be utilized unless approved by the Town. The Engineer shall submit documentation to the Town for its review and approval demonstrating that the joint restraint system to be utilized will provide the needed restraint. The Contract Documents shall specify the joint restraint method to be used and shall clearly indicate the minimum length of piping requiring joint restraint.

- 3.4.6.9.2 The use of combined thrust restraint systems employing concrete blocking and joint restraint devices, based on each system being designed to resist a percentage of the resultant thrust force, shall not be permitted. The use of combined systems based on each system being designed to resist all of the resultant thrust force are permitted.

- 3.4.6.10 The Contract Documents shall include the requirement that NC One Call shall be contacted forty-eight (48) hours prior to any excavation. The documents shall also note that locations of existing utilities by NC One Call are valid only for ten (10) days after the date of location.

### 3.4.7 Backfilling

- 3.4.7.1 Backfilling shall be performed only with the approval of a Town's Representative.

- 3.4.7.2 Terms used to indicate backfill zones are capitalized and are defined in Section 1.3.1.2.
- 3.4.7.3 Special care shall be taken in writing the Contract Documents so that backfilling for water mains and appurtenances will be done in a manner which will provide satisfactory support and restraint of all pipes, fittings, valves, equipment and structures. As a minimum, Initial Backfill for water mains shall be compacted to 95% Standard Proctor as determined by the AASHTO-T99 method.
- 3.4.7.4 The Haunching and the Initial Backfill shall be free of materials which might in any way damage the pipe or preclude proper compaction of the backfill. Acceptable soil materials are ASTM 2487 soil types SW, SP, SM and SC.
- 3.4.7.5 The Final Backfill shall be provided using materials and methods suitable to provide the compaction necessary to prevent settlement which would adversely affect existing or proposed land use. Unless otherwise permitted by the Town, compaction shall be no less than 90% Standard Proctor as determined by AASHTO-T99. Backfilling within the right-of-way of the NCDOT, the Town of Beaufort, railroads, and other rights-of-way shall be subject to the right-of-way owner's requirements.
- 3.4.7.6 All water mains shall be installed with three-inch (3") wide metallic detectable tape. The tape shall be clearly marked "Water" and shall be centered over the main, twelve inches (12") below finished grade. Any breaks in the tape shall be repaired in accordance with the manufacturer's recommendations.
- 3.4.7.7 The Contract Documents shall require the disturbed ground surface to be graded to prevent ponding of water, and to be seeded and mulched upon completion of backfilling operations. Seeding and mulching shall be in accordance with the requirements and recommendations of the Land Quality Section of the Division of Land Resources.

#### 3.4.8 Termination of Water Mains

Water mains shall be terminated in accordance with the Standard Details. Provide either blow-offs or hydrants as required by Section 3.2.10 of the Manual.

#### 3.4.9 Installation of Services

- 3.4.9.1 Services shall be provided to each lot or individual building unit as required by Section 3.2.9 of this Manual and as shown in the Standard Details. Meter boxes and brick for one-inch (1") services shall be provided by the Contractor as shown on the Standard Details. Meter boxes installed for multi-family developments and ganged together shall be marked with the unit number being

served. Markings shall be permanently painted on the inside of the frame section and highly visible.

3.4.9.2 When service is available from two (2) or more water mains, the property shall be served by the main designated by the Town.

3.4.9.3 Standard services are available utilizing 3/4", 1", 1 1/2", and 2" meters. Service tubing for 3/4", and 1" services shall be 1" diameter. Service pipe for 1-1/2" and 2" services shall be 2" diameter. For additional information, refer to the Standard Details. Larger services such as four-inch (4"), six-inch (6"), eight-inch (8"), etc., may be specified. Services larger than two-inch (2"), if used, shall be designed as a dead-end water main except that a permanent blow-off rather than a hydrant may be provided for flushing purposes.

3.4.9.4 Service connections for one-inch (1") services shall be installed by the use of a service clamp.

3.4.9.5 One-inch (1") service tubing shall be installed with sufficient slack to prevent tension on the line. A maximum of one splice (coupling) per service shall be allowed. Tubing shall have a minimum cover of twenty-four inches (24"). See the Standard Details.

3.4.9.5.1 Service tubing shall be installed with a minimum of six inches (6") of vertical separation from an existing or proposed storm drain.

3.4.9.5.12 If the service tubing is damaged during construction such that its flow capacity or its life expectancy is adversely affected, the damaged portion shall be replaced.

3.4.9.6 One and one-half inch (1-1/2") and two-inch (2") diameter services shall be installed in accordance with the Standard Details. The installation of the Class 200 PVC service pipe shall be in strict conformance with the requirements for mains, except that the service pipe shall have a minimum cover of twenty-four inches (24").

#### 3.4.10 Setting of Valves and Valve Boxes

3.4.10.1 Valves shall be set at the locations directed in Section 3.2.7 of the Manual and as shown in the Standard Details.

3.4.10.2 All valves shall be installed with a cast iron valve box meeting the specifications of Section 10.3.4 of the Manual. The boxes shall be set plumb with the bottom of the box resting on compacted backfill. Valve boxes for two-inch (2") ball valves shall be supported by two (2) bricks. The box shall not contact the valve or water main.

The top of the box, when located in unpaved areas, shall be centered, and set in a 24-inch X 24-inch X 6-inch depth concrete pad or precast concrete collar set flush with the finished grade. See Standard Details.

- 3.4.10.3 Valve boxes shall be installed so that a minimum of four inches (4") of upward and four inches (4") of downward total of eight inches (8") vertical adjustment is possible without disturbing the base or removal of any box sections. Valve box extensions shall be in accordance with Section 10.3.4 of the Manual.

#### 3.4.11 Setting of Fittings

The specifications shall insure that care is taken in setting fittings so that the joints bell up properly. The fittings shall be properly supported and thrust blocked in accordance with Section 3.4.6.9 of the Manual.

#### 3.4.12 Installation of Air Release Valves and Blow-offs

- 3.4.12.1 Blow-offs and drainage branches shall not be connected to any sewer, submerged in any stream, or be installed in any other manner which will permit back siphonage into the distribution system.
- 3.4.12.2 Automatic air release valves shall be installed in standard manholes free of infiltration. In cases where automatic air release valves are permitted or required by the Town for use on a water main, such valves shall be equipped with a vacuum check device to prevent backflow in the event of main pressure loss.
- 3.4.12.3 Manual air release valves shall be installed in a standard meter box located outside of traffic areas where possible. The air release valve shall be provided by tapping the main and installing a standard service clamp, a corporation stop, one-inch (1") service tubing and an angle meter stop as shown in the Standard Details. The one-inch (1") tubing shall have a minimum cover of twenty-four inches (24").

#### 3.4.13 Installation of Backflow Prevention Devices

- 3.4.13.1 Backflow prevention devices shall be located in accordance with Section 3.2.11.
  - 3.4.13.1.1 Reduced Pressure Principle devices shall be installed such that they vent to the atmosphere and are not subject to submergence, or temperatures below freezing. Above ground installations shall meet the applicable requirements of the rights-of-way owner and Town zoning setbacks. The Town will not be responsible for the operation and maintenance of the device and recommends to the owner a heating device be installed to prevent freezing.
  - 3.4.13.1.2 Double Check Detector Check devices may be installed either in or above ground but must have positive drainage away from the vault or enclosure. Installations that do not provide positive drainage away from the vault will require the installation of a sump pump. Above ground installations shall



meet the applicable requirements of the rights-of-way owner and city zoning setbacks. The Town of Beaufort will not be responsible for the operation and maintenance of the device and recommends to the owner a heating device be installed to prevent freezing in an above ground installation.

- 3.4.13.1.3 Owner to have backflow devices inspected and tested annually. A report of such testing shall be submitted to the Town.

3.4.14 Setting of Fire Hydrants

Fire hydrants shall be installed in accordance with the Standard Details. Restraint of the hydrant branch valve shall be accomplished by utilizing a locked hydrant tee meeting the requirements of Section 10.2.6.4.

3.4.15 Roadway, Street and Railway Crossings

- 3.4.15.1 Railway and NCDOT roadway crossings of water mains shall be performed in accordance with the requirements of the right-of-way owner and with the conditions set forth in the encroachment agreement. The materials as a minimum must meet the requirements of the Manual and must in addition meet or exceed the standards of the particular right-of-way owner.
- 3.4.15.2 The actual patching of Town pavement shall be performed by the Town at the expense of the permit holder. As a minimum, ABC stone shall be replaced beginning two inches (2") below the bottom of the existing stone and filled to the grade of the adjacent pavement and compacted.
- 3.4.15.3 All boring and jacking installations shall be accomplished with the use of encasement pipe which as a minimum meets the specifications set forth in Section 10.9 of the Manual. The carrier pipe shall be DIP with "push-on" joints in conformance with and conform to the requirements of Paragraph Section 10.2.4 of this Manual. The ends of the encasement pipe shall be sealed as shown in the Standard Details. All additional expenses for boring and jacking shall be paid by the developer.

**3.5 CLEANING AND TESTING OF WATER SYSTEM EXTENSIONS**

3.5.1 General

The Contract Documents for water system extensions shall provide written requirements for thorough cleaning, testing, and disinfection of the new extension. The following guidelines are intended to aid the Engineer in developing specifications which will insure sound and properly disinfected water lines.

3.5.2 Test Sequence

The following test sequence shall be included in all water system extension specifications unless otherwise directed by the Town.

- (1) Perform pretest inspection.
- (2) Clean the main.
- (3) Perform the hydrostatic tests.
- (4) Disinfect the water main in accordance with the latest revision of ANSI/AWWA C651
  - (a) Apply the proper dosage of chlorine.
  - (b) Allow chlorine solution to remain in the water main a minimum of 24 hours.
  - (c) Take bacteriological samples as directed by the Town's representative.
    - (i) Bacteriological testing shall comply with Section 5 of AWWA C651. All samples shall be tested for bacteriological (chemical and physical) quality in accordance the Standard Methods for the Examination of Water and Wastewater; and shall show the absence of coliform organisms and the presence of chlorine residual. The lines shall not be placed in service until they have been pressure tested and a negative bacteriological report has been received from the Town of Beaufort.

### 3.5.3 Pretest Inspection

Prior to the commencement of hydrostatic testing and chlorination, the Town shall be contacted to request scheduling of inspection and testing. A Town's Representative shall visually inspect the completed installation prior to testing to ensure that all fire hydrants, valves and other appurtenances have been installed and are operable. All defects disclosed by the inspection shall be corrected prior to testing.

### 3.5.4 Cleaning of the Main

Mains shall be cleaned only in the presence of a Town Representative. No valves or hydrants owned by the Town of Beaufort shall be operated without the express permission of the Town.

#### 3.5.4.1 Cleaning of Water Mains Smaller than 4" in Diameter

Mains shall be cleaned by flushing. Flushing velocity shall be adequate to remove all debris and other undesirable material and a minimum of 2-1/2 feet per second.

#### 3.5.4.2 Cleaning of Water Mains 4" and Larger in Diameter

Mains shall be cleaned only in the presence of a Town Representative. No valves or hydrants owned by the Town of Beaufort shall be operated without the express permission of the Town. Cleaning shall be accomplished by passing through the pipe a polyurethane "pig" of the appropriate size and density (as manufactured by Poly-Pig or approved equal). Pig(s) shall be furnished by the Contractor. The procedure shall be as follows:

- a. The Contractor shall prepare the main for the installation and removal of pig(s) as required:
  - (1) In general, this will consist of furnishing all equipment, material, and labor to satisfactorily install and remove the pig(s).
  - (2) Prior to scheduling a preconstruction conference, a "pigging" plan shall be submitted to the Town for approval.
  - (3) Where expulsion of the pig is required through a dead end main, the Contractor shall prevent the backflow of purged water into the main after expulsion of the pig. For pipe twelve inches (12") or less in diameter, purged water can be prevented from re-entering into the pipe by the temporary installation of pipe and fittings as required to provide a riser with an above ground discharge. On larger pipe, additional excavation of the trench may serve the same purpose.
  - (4) After expulsion of the pig, completion of flushing, and at the direction of the Town, the Contractor shall complete work at openings by plugging, blocking, backfilling and completion of all appurtenant work necessary to secure the system.
- b. Under supervision of the Inspector, pig(s) shall be propelled via water pressure through the main(s) from point of insertion to point of expulsion. Where mains are in the form of a loop, the Contractor shall "pig" the complete system.
- c. As an alternative to "pigging", dead end pipes of less than 100 feet in length which are difficult to "pig" may be cleaned by flushing. Flushing shall be accomplished in the same manner as that required for pipes less than four inches (4") in diameter in accordance with Section 3.5.4.1.

### 3.5.5 Hydrostatic Test

Unless otherwise permitted, testing shall be performed between each main line valve in accordance with AWWA C600 (Ductile Iron Pipe) and C605 (PVC Pipe). The Town will, except when certain circumstances dictate otherwise, permit the lengths of test sections to be a maximum of 1500 feet in subdivisions or other areas where the new main has closely

spaced valves. Testing shall be done only in the presence of a Town's Representative, unless otherwise directed by the Town. Testing shall be performed using a suitable pump and an accurate gauge graduated in 1.0 psi increments. The section of the main to be tested shall be subjected to a test pressure of 150 psi for a period of two (2) hours. The leakage of the test section shall be accurately determined and compared to the schedule shown below. All visible leaks shall be repaired regardless of the amount of leakage.

<b>PIPE SIZE (inches)</b>	<b>ALLOWABLE LEAKAGE (Gallons per hour per 1000 feet of pipe)</b>
2	0.16
4	0.33
6	0.50
8	0.66
10	0.83
12	0.99
14	1.29
16	1.47
18	1.66
20	1.84
24	2.21
30	2.76
36	3.31

If the leakage is greater than the allowable leakage as given by the above table, the Contractor shall replace any defective materials and perform all necessary work to ensure that the installation is acceptable and a retest shall be performed subsequent to any repair work performed. Remedial repair work and retesting shall be repeated until the leakage occurring during the test period is less than or equal to the allowable leakage.

#### 3.5.6 Chlorination

- 3.5.6.1 Chlorination shall be performed only in the presence of the Town's Representative and shall be performed only after the line is complete and has tested satisfactorily for leakage.
- 3.5.6.2 Chlorination taps will be made within five (5) pipe diameters of the water main control valve at the upstream end of the line and at all extremities of the line.
- 3.5.6.3 Sufficient chlorine solution shall be applied to bring the concentration within the main to a minimum of 100 ppm free chlorine residual.
- 3.5.6.4 The chlorine solution shall be introduced to the main at a constant rate while regulating the flow of water through the main being chlorinated such that the required concentration of chlorine is achieved throughout.
- 3.5.6.5 All valves within the section of main being chlorinated shall be operated once during the contact period.
- 3.5.6.6 The chlorine solution shall remain in the lines for no less than twenty-four (24) hours, longer if so directed by the Town.
- 3.5.6.7 Services shall be chlorinated at the same time and by the same method utilized for the main.

- 3.5.6.8 Extreme care shall be taken to prevent contamination of existing water mains during the test period. If, in the opinion of the Town, an existing main is contaminated, the section of main subjected to the possible contamination shall be flushed and chlorinated in accordance with the requirements for new mains.
- 3.5.6.9 The Town will advise the Contractor when a suitable period of time has elapsed for chlorine contact. The main shall be flushed thereafter in the presence of the Town's Representative. The flushing of the main shall be considered complete when the chlorine concentration within the main is less than or equal to the lesser of the following values:
  - 1. part per million (ppm)
  - 2. free chlorine
  - 3. free chlorine concentration within the existing main to which the extension has been connected.
- 3.5.6.10 The Contractor shall be responsible for insuring that high-strength chlorine solution is contained on-site and not allowed to make its way to any watercourse, stream, creek, lake, or other body of water.
- 3.5.7 Bacteriological Testing
  - 3.5.7.1 After completion of chlorination and flushing, the Contractor shall obtain sufficient bacteriological samples for complete testing.
  - 3.5.7.2 The Town shall determine the location of samples and the number of samples necessary to provide a test group which is representative of the section of main being tested.
  - 3.5.7.3 A failure of any sample of a test group shall constitute failure of the entire test group from which the sample was taken. Such failure shall require two (2) successive passing test groups to substantiate that the main has been satisfactorily chlorinated. The second of the two successive test groups of samples will not be collected before nor unless the first group has passed. The Contractor may, at his option, rechlorinate and retest the section of water main upon failure of the test group.
  - 3.5.7.4 If two (2) successive bacteriological test groups fail, the section of main from which the group was taken shall be rechlorinated and retested until the main is shown to be properly chlorinated in accordance with Section 3.5.6 above.
  - 3.5.7.5 The laboratory secured for testing shall be certified by the State Laboratory of Public Health. All sample bottles for bacteriological sampling provided by the laboratory shall be sterilized and treated with a dechlorinating agent, such as sodium thiosulfate.

## SECTION 10.0

### MATERIAL SPECIFICATIONS FOR WATER SYSTEM EXTENSIONS

#### 10.1 GENERAL

The materials used for the construction of water mains and all accessories and appurtenances thereof shall be new, free of defects in product and workmanship and of the highest quality available in the industry. Materials not specified but deemed equal to those specified may be approved for use provided the documentation and samples necessary for approval are provided to the Town thirty (30) days prior to the ordering of said materials. WRITTEN APPROVAL must be issued by the Town before such material may be used in construction. Current specifications (latest revisions) shall apply in all cases where materials are described by reference to published standards such as ASTM, AWWA, ANSI, etc.

#### 10.2 WATER MAIN AND FITTINGS

Water mains shall be constructed of polyvinyl chloride (PVC) or ductile iron pipe (DIP) at the option of the Developer or Engineer, except in instances where the Manual or the Town specifically requires a particular pipe material be utilized for an installation. All plastic pipe shall bear the seal of the National Sanitation Foundation.

10.2.1 PVC water main four inches and larger shall be manufactured in accordance with AWWA Standard C-900. The pipe shall have push-on type joints with elastomeric gaskets. The pipe shall be pressure rated at 150 psi with a dimension ratio of 18 for both bell and pipe thickness. Pipe shall be furnished in nominal twenty-foot (20') lengths.

10.2.2 PVC water main three inches and smaller shall be Class 200 SDR 21 conforming to ASTM D1784 and ASTM D2241 with "push-on" joints. Fittings shall be Schedule 80 PVC with solvent weld joints. Pipe shall be furnished in nominal twenty-foot (20') lengths.

10.2.3 Tees, elbows and other fittings for PVC C-900 pipe and ductile iron pipe shall be of ductile iron unless otherwise permitted or required by the Town. Standard dimension fittings or compact fittings may be used in accordance with the requirements of this Section.

- 10.2.3.1 The interior of all fittings shall be cement mortar lined with an asphaltic coating in accordance with AWWA Standard C-104 (ANSI 21.4). The exterior of all fittings shall have a one (1) mil bituminous coating in accordance with AWWA Standard C-110 (ANSI A21.10).
- 10.2.3.2 Compact fittings shall be ductile iron with either push-on or mechanical joints in accordance with ANSI/AWWA C153/A21.53-84. Cement lining and asphaltic coating shall be provided in accordance with ANSI/AWWA C104/A21.4.
- 10.2.3.3 Standard dimension fittings for PVC C-900 pipe and ductile iron pipe shall be of ductile iron with either "push-on" or mechanical joints (See Section 3.4.6.5). The fittings shall comply with all requirements of AWWA Standard C-110 (ANSI A21.10) and shall be designed for a minimum working pressure of 150 psi plus 100 psi surge pressure.
- 10.2.4 Ductile iron pipe for water mains shall be manufactured in conformance with AWWA C-151 and shall be cement-mortar lined with an asphaltic coating in accordance with AWWA C-104. The exterior of the pipe shall be bituminous coated in accordance with AWWA C-151. The minimum thickness Class of pipe shall be Class 50. Pipe shall be furnished in nominal 18 or 20 foot lengths. Pipe joints for ductile iron pipe shall be "push-on" unless the additional pipe deflection allowed by mechanical joints is necessary or other considerations dictate the use of mechanical joints (See Section 3.4.6.5). The joints for ductile iron pipe shall conform to AWWA Standard C-111 revision (ANSI A21.11).
  - 10.2.4.1 Polyethylene encasement shall be applied to underground ductile iron pipe and fitting installations when called for on the drawings. Materials and installation procedures shall be in accordance with ANSI/AWWA C-105/A21.5-88.
- 10.2.5 Detectable marking tape shall be installed in accordance with Section 3.4.7.6. Tape shall be three (3) inches in width with a minimum thickness of 0.5 millimeters (minimum solid center foil thickness of 0.35 millimeters). Color of the tape shall be blue meeting the American Water Works Association color code. Tape shall read: "Caution – Buried Water Line Below". Tape shall be



manufactured by Lineguard, Inc., Pro-Line Safety Products Co.,  
Empire Level Mfg. Corp., or approved equal.

#### 10.2.6 Restraint Devices

10.2.6.1 Restraint devices for use on ductile iron and C-900 PVC “push-on” joints shall be constructed of high strength ductile iron, ASTM A536, Grade 65-45-12 and shall incorporate machined serrations on the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength, low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Block Buster Series 1390-C, Star Pipe Products Allgrip series 3600 and Pipe Restrainers Series 1200S or approved equal.

10.2.6.2 Restraint devices for use on mechanical joint to C-900 PVC, shall be constructed of high strength ductile iron, conforming to the requirements of ASTM A536, Grade 65-45-12, and shall incorporate machined serrations on the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Series 1500, Star Pipe Products, Allgrip Series 3600, Romac Industries, Inc GripRing or approved equal.

10.2.6.3 Restraint devices for use on mechanical joint ductile iron, shall be constructed of high strength ductile iron, conforming to the requirements of ASTM A536, Grade 65-45-12, and shall incorporate machined serrations on

the inside diameter to provide positive restraint, exact fit, full circle contact and support of the pipe in an even and uniform manner. Bolts and connecting hardware shall be of high strength low alloy material in accordance with ANSI/AWWA C111/A21.11, latest revision thereof. All devices shall have a safety factor of no less than 2:1 at the full rated pressure of the pipe on which it is installed. They shall be UL listed and Factory Mutual approved. Restraining devices shall be Uni-Flange Series 1300-C, Star Pipe Products, Allgrip Series 3600, Romac Industries, Inc. GripRing or approved equal.

10.2.6.4 Locked hydrant tees and fittings for fire hydrants shall meet the requirements of AWWA Standard C-111 (ANSI A21-11). Locked tees shall be as manufactured by American Cast Iron Pipe Company, Clow, U.S. Pipe, or approved equal.

10.2.6.5 Bolted Couplings for PVC C-900 pipe and ductile iron pipe shall be constructed of a center sleeve and end rings of ductile iron in accordance with ASTM A536. Bolts and nuts shall be of high strength, low alloy steel per ASTM A242 and AWWA C-111. Center sleeve and end rings shall have a paint finish coat. Couplings shall be Ford Style FC1, Romac 501 Series, Smith Blair 441, or JCM 201.

### 10.3 MAIN VALVES AND BOXES

#### 10.3.1 General

Main line valves for 12-inch nominal diameter mains and smaller shall be resilient-seated gate valves. All larger water main valves shall be rubber seated butterfly valves. Valve boxes shall be cast iron with traffic bearing capability.

#### 10.3.2 Gate Valves

Gate valves shall conform to the requirements of the latest revision of AWWA Specification C-509/C-515 for resilient-seated gate valves.

10.3.2.1 The valve body shall be ASTM A-126 Class B cast iron or ductile iron and shall conform to ASTM A395 or

ASTM A536. In addition, ductile iron shall contain no more than 0.08 percent phosphorus. Valve shall have a smooth bottom design.

10.3.2.2 All interior valve parts and surfaces shall be of corrosion resistant materials or have an epoxy coating sufficient to prevent corrosion and at a minimum be 8 mils thick. Such coating shall be recognized by the AWWA for potable water use. Exterior valve parts and surfaces shall be epoxy coated of at least 8 mils thick. Valve seating shall use compression closure.

10.3.2.3 The valves shall open counter clockwise and have non-rising stem operation with 2-inch square operating nuts. The maximum number of turns required to fully open or close the valve shall equal three times the pipe diameter plus two.

10.3.2.4 The stem shall be of corrosion resistant material and have "O" ring seals.

10.3.2.5 Valves shall provide zero leakage at a working pressure of 200 psi in either direction of line flow.

10.3.2.6 Valves shall have flange connections conforming to ANSI B16.1 Class 125 or mechanical joints conforming to AWWA C-111.

10.3.2.7 Valves shall be manufactured by Mueller, or equal.

### 10.3.3 Butterfly Valves

Butterfly valves shall be rubber seated manufactured in conformance with AWWA C-504.

10.3.3.1 The valve body shall be ASTM A-126 Class B cast iron.

10.3.3.2 All interior valve parts and surfaces shall be of corrosion resistant materials or have a suitable epoxy coating recognized by the AWWA for potable water use. Exterior valve parts and surfaces shall be epoxy coated or have the Standard AWWA coating.

- 10.3.3.3 The shaft shall be of sufficient diameter and strength to comply with the requirements for maximum operating torque set forth in AWWA C 504 for Class 150 B.
- 10.3.3.4 Operation shall be by way of a geared actuator suitable for direct bury installations. The maximum number of turns required to fully open or close the valve shall equal three times the pipe diameter plus two. Access to the operating nut shall be provided by standard telescoping cast iron valve box in compliance with Section 7.3.4.
- 10.3.3.5 Valves shall provide a bubble tight seal with a pressure differential of 150 psi in either direction of line flow.
- 10.3.3.6 Valves shall have flange connections conforming to ANSI B16.1 Class 125 or mechanical joints conforming to AWWA C-111.
- 10.3.3.7 Valves shall be manufactured by Clow, American Flow Control, Mueller, or Pratt.

#### 10.3.4 Valve Boxes

- 10.3.4.1 Valves 2" through 10" - Valve boxes shall be of cast iron suitable for H-20 loading. The manufacturer's name and part number shall be cast into each component of the box. The box shall be of the screw type consisting of a base section, center extensions as necessary, and a top section with a cover marked "WATER". Sections shall be selected and installed such that a minimum of four inches (4") of future adjustment (upward and downward) is possible without section removal or replacement and without the use of adapters.
- 10.3.4.2 Valves 12" and Larger – Valve box shall consist of an East Jordan Iron Works – 157801 frame and cover with a valve box bottom and extensions, as needed in accordance with Section 10.3.4.1. Installation shall be in accordance with the Standard Details.

### 10.4 HYDRANTS

#### 10.4.1 Fire Hydrants

10.4.1.1 Fire hydrants shall be in accordance with AWWA Standard C-502, latest revision thereof, suitable for an operating pressure of not less than 150 pounds per square inch and shall have a traffic breakable feature (safety flange and stem coupling), dry top, sealed lubrication reservoir and a main valve which is held closed with pressure. The hydrant body shall be of cast iron with "O" ring seals and bronze threads on the seat ring and drain ring. Hydrants shall be hub end, triple nozzle, with two 2½-inch fire hose nozzles and one 4½-inch pumper nozzle with American National Standard hose threads. Pumper nozzle shall be fitted with a screw-on 4-inch Storz adaptor with locking cap. The 2½-inch nozzles shall be provided with caps and chains. The hydrant main valve shall be a minimum of 5-1/4 inches in diameter. All continuously wetted hydrant parts and surfaces shall be of corrosion resistant materials or be epoxy coated with epoxy recognized by AWWA for potable water use. The epoxy coating shall be of a color other than black (unless the word "epoxy" is stenciled on the base) to permit distinction between standard and epoxy coatings to be made easily. Hydrants shall be Mueller Super Centurion A-421.

10.4.1.2 The inlet shoe for a fire hydrant shall have a six-inch (6") inside diameter and shall be cast or ductile iron with mechanical joint fittings in accordance with AWWA Standard C-110.

#### 10.4.2 Hydrants for Blow-Offs

10.4.2.1 Blow-offs as provided for in Section 3.2.10.1 of the Manual shall be standard fire hydrants meeting the requirements of Section 10.4.1(above).

10.4.2.2 Auto Flushing Devices as required by Sections 3.2.10.2 and 3.2.10.3 of the Manual shall be as shown in the Standard Details.

### 10.5 WATER SERVICE MATERIALS

#### 10.5.1 Materials for 1" Services

The materials for 3/4" and 1" services are identical except for the meter which is installed by the Town. Also, materials for 1-1/2" and 2" services are identical except for the meter vault which is installed by the Town.

10.5.1.1 A. Specification for Brass Services Saddles C900 PVC Pipe (Cast Iron Size O.D.)

Service Saddles shall be certified 85-5-5-5 waterworks brass per ASTM B62 and/or ASTM B584, UNS No. C83600 and AWWA C-800 and shall be of the one-piece design style. The Saddle shall have its top and bottom section hinged together with a silicon bronze pin. The lower brass casting will be tapped to accept a silicon bronze screw, which has a combination slot-hex head. The screw is used to tighten the upper and lower castings around the pipe forming a watertight seal against the PVC pipe. The hydraulic seal for 3/4" & 1" taps will be an EPSM rubber O-Ring design conforming to ASTM-D2000: M5CA710, a Buna-N gasket per ASTM-D2000 for 1-1/2" & 2" taps.

The saddles shall conform to the Uni-Bell PVC Pipe Association and the American Water Works Association recommendations for saddles used on PVC pipe. Specifically, the brass saddle body shall be preformed to the radius of the pipe so as to not distort the pipe when the saddle is tightened. The bottom half of the hinged section will be at least 2" wide.

The saddles shall have CC/AWWA threads. A machined "groove" at the top outside edge of the saddle boss casting shall be used to determine that the saddles are machined with CC/AWWA threads.

The saddles shall be manufactured by a company that holds a certificate of registration to the International Standards Organization for the ISO 9001 standard or a later revision. This standard establishes a model for quality assurance in design/development, production, installation, and service. The manufacturer must certify upon request prior to the bid date that it holds this certificate, as current and in good standing.

The saddles shall be listed in the Underwriters Laboratories Listing of Drinking Water System Components in Accordance with ANSI/NSF 60 & 61.

This specification is for 1-1/2" through 8" nominal pipe sizes.

The Saddles will be the S90-xxx Style as manufactured by the Ford Meter Box Company, Inc., Wabash, Indiana or an equal approved prior to the bid. All exceptions shall be submitted prior to the bid date.

**B. Specifications for 10" and 12" Brass Service Saddles S90 Style (3/4" & 1" Taps) For C900 PVC Pipe (Cast Iron Size O.D.)**

Service Saddles shall be certified 85-5-5-5 waterworks brass per ASTM B62 and/or ASTM B584, UNS No. C83600 and AWWA C-800 and, shall be two-piece, bolted design. Silicon bronze slotted hex head bolts (1/2" x 3" long) are used to tighten both sections around the pipe. The hydraulic seal for 3/4" and 1" taps will be an EPDM rubber O-Ring design conforming to ASTM-D2000: M5CA710, a Buna-N gasket per ASTM-D2000. The saddle shall be manufactured to provide 360-degree support of the pipe, at least 2" wide.

The saddles shall conform to the Uni-Bell PVC Pipe Association and the American Water Works Association recommendations for saddles used on PVC pipe.

The saddles shall have CC/AWWA threads. A machined "groove" at the top outside edge of the saddle boss casting shall be used to determine that the saddles are machined with CA/AWWA threads.

The saddles shall be manufactured by a company that holds a certificate of registration to the International Standards Organization for the ISO 9001 standard or a later revision. This standard establishes a model for quality assurance in design/development, production, installation, and service. The manufacturer must certify upon request prior to the bid date that it holds this certificate, as current and in good standing.

The saddles shall be listed in the Underwriters Laboratories Listing of Drinking Water System Components in Accordance with ANSI/NSF 60 & 61.

The saddles shall be the 10" and 12" S90 Style, as manufactured by the Ford Meter Box Company, Inc., Wabash, Indiana, or pre-approved equal. All exceptions shall be submitted prior to the bid date.

**10.5.1.2 Specification for 3/4" Plug/Key Style Corporation Stops**

This specification covers ¾" Plug/Key Style Corporation Stops with ¾" AWWA/CC taper thread inlet by ¾" Grip Joint outlet connections for copper or copper tube size plastic (CTS). The corporation stops shall conform to AWWA Standard C800 and latest revisions regarding thread types, diameters, materials and design. All cast components shall be certified waterworks red brass meeting the latest revision of AWWA Standard C800, ASTM B62 and/or ASTM B584, UNS No. C83600. The alloy described by this Standard is 85% copper and 5% each of tin, lead and zinc (85-5-5-5).

Each stop shall be watertight and individually tested for leaks, batch testing is not allowed. The waterway diameter shall be approximately equivalent to the nominal size of the stop and shall accommodate the maximum cutter size established by AWWA C800. Inlet shall be AWWA tapered threads unless iron pipe threads are specified. All threads shall be capped for protection against damage during shipment or handling. Stops shall be shipped well boxed and marked with the size and type. All stops shall be well designed, have good appearance and shall be entirely suitable for the intended purpose.

The Grip Joint shall affect a watertight seal on the service line by compression of a bevelled rubber gasket, which simultaneously activates a metal phosphorous Gripper Ring Restraint. An Anti-friction washer shall separate the gasket and Gripper Ring. A bronze nut shall encapsulate the working components and shall tighten the rubber gasket and the Gripper Ring around the service line. The Grip Joint shall have a positive stop to ensure the installation is complete. A complete installation shall provide the maximum gasket seal without unnecessary guesswork. The Gripper Ring shall be reusable; it shall return to its original, pre-installed shape to allow re-installation. Gasket tabs shall help retain the gasket, anti-friction ring and Gripper Ring within the Grip Joint if the nut is removed from the fitting.

The corporation stops shall be manufactured by a company that holds a certificate of registration to the International Standards Organization for the ISO 9001 standard or a later revision. This standard establishes a



model for quality assurance in design/development, production, installation and service. The manufacturer must certify upon request prior to the bid date that it holds this certificate, as current and in good standing.

The 3/4" Plug/Key Style Corporation Stops shall be the F1000-3-G as manufactured by the Ford Meter Box Company, Inc., Wabash, Indiana, or pre-approved equal. All exceptions shall be submitted prior to the bid date.

- 10.5.1.3 Specification for 1" Plug/Key Style Corporation Stops  
This specification covers 1" Plug/Key Style Corporation Stops with 1" AWWA/CC taper thread inlet by 1" Grip Joint outlet connections for copper or copper tube size plastic (CTS). The corporation stop shall conform to AWWA Standard C800 and latest revisions regarding thread types, diameters, materials and design. All cast components shall be certified waterworks red brass meeting the latest revision of AWWA Standard C800, ASTM B62 and/or ASTM B584, UNS No. C83600. The alloy described by this Standard is 85% copper and 5% each of tin, lead and zinc (85-5-5-5).

Each stop shall be watertight and individually tested for leaks; batch testing is not allowed. The waterway diameter shall be approximately equivalent to the nominal size of the stop and shall accommodate the maximum cutter size established by AWWA 800. Inlet shall be AWWA tapered threads unless iron pipe threads are specified. All threads shall be capped for protection against damage during shipment or handling. Stops shall be shipped well boxed and marked with the size and type. All stops shall be well designed, have good appearance and shall be entirely suitable for the intended purpose.

The Grip Joint shall affect a watertight seal on the service line by compression of a bevelled rubber gasket, which simultaneously activates a metal phosphorous Gripper Ring restraint. An Anti-friction washer shall separate the gasket and Gripper Ring. A bronze nut shall encapsulate the working components and shall tighten the rubber gasket and the Gripper Ring around

the service line. The Grip Joint shall have a positive stop to ensure the installation is complete. A complete installation shall provide the maximum gasket seal without unnecessary guesswork. The Gripper Ring shall be reusable; it shall return to its original, pre-installed shape to allow re-installation. Gasket tabs shall help retain the gasket, anti-friction ring and Gripper Ring within the Grip Joint if the nut is removed from the fitting.

The corporation stops shall be manufactured by a company that holds a certificate of registration to the International Standards Organization for the ISO 9001 standard or a later revision. This standard establishes a model for quality assurance in design/development, production, installation, and service. The manufacturer must certify upon request prior to the bid date that it holds this certificate, as current and in good standing.

The 1" Plug/Key Style Corporation Stops shall be the F1000-4-G as manufactured by the Ford Meter Box Company, Inc., Wabash, Indiana, or pre-approved equal. All exceptions shall be submitted prior to the bid date.

- 10.5.1.4 Specification for 1" Meter Setters – The meter setting device shall consist of a brass bottom bar with CTS pack joint inlet and Double Purpose outlet service line connections, riser pipes of 1" I.D. and of 1.125" O.D. copper tubing, and inlet Key Type Angle Meter Valve and an outlet Angle Meter Valve. The meter setting height shall be 10-25/32" or as specified. All necessary gaskets shall be furnished with each meter setter. All solder joints shall contain lead-free solder. All copper risers shall be bent without the use of heat.

The Key Type Angle Meter Valve shall be precision machined to ensure an accurate fit for a complete watertight seal. An EPDM O-ring within a machined groove ring at the top of the key will provide additional protection against leakage from the top of the key. Two phosphor bronze spring washers, located between the tee head and the valve body, shall assist the inlet water pressure in holding the tapered key in place. The key and tee head shall be securely locked together by means of a bronze pin. The valve shall have a substantial tee head for operating and closing with a 90 degree rotation of a standard slotted wrench. The valve shall have

stops and lugs for controlling the tee head rotation. Each valve shall be watertight and individually tested for leaks. The swivel meter nut shall be held in place by a silicon bronze ring and shall rotate smoothly without binding. The valve shall have padlock wings to lock the valve in the closed position.

Angle Globe Meter Valve shall be 1" Female Iron Pipe threads on the outlet, with approximately 1/2" x 15/16" hexagonal wrench flats, measuring approximately 1-11/16" from flat to opposite flat. The 1" swivel meter nut shall be held in place by a silicon bronze snap ring and shall rotate smoothly without binding. The meter nut shall have an approximate 5/8" x 1-1/16" wide hexagonal wrench flats, measuring approximately 1-15/16" from flat to opposite flat for service installation. The meter nut shall be drilled in two locations for a seal wire and shall include an integral cast saddle extending beyond the meter nut threads to cradle the meter in position before engaging the meter threads. This facilitates meter installation and helps prevent cross threading. The machined valve stem shall include a straight grip handle, attached with a silicon bronze hex locking nut. The handle shall engage the stem with matching four-sided flats that prevent the handle from slipping during valve operation. The stem packing nut, with gland, is threaded to the top of the valve bonnet to properly seal the bonnet and stem. The base of the stem shall have a 1-1/8" O.D., with 1/16" thickness, flat Buna-N rubber gasket seat, which is attached by a copper washer and silicon bronze hex locking nut. The gasket shall seal against a precision machined brass seat when the valve is closed. The valve bonnet is assembled to the valve body by 1-3/8" x 16 threads and includes an EODM o-ring at the top of the threads for proper seal against the machined body surface. The valve shall fully open or close with approximately 4-3/4 full rotations of the handle. The valve body (and seat), bonnet, stem, stem packing glad nut and handle shall be manufactured from 85-5-5-5 brass.

The Coppersetter shall conform to the latest AWWA Standard C800 regarding thread types and diameters. All brass castings shall be certified waterworks red brass, ASTM B62 and/or ASTM B584, UNS No.

C83600, composed of 85% copper and 5% each of tin, lead and zinc. The Copper tubing shall be per ASTM B88, copper alloy #122. All copper shall have approximately 1/16" wall thickness per ASTM B88 for K copper. Each Coppersetter shall be watertight and individually tested for leaks.

The Pack Joint nut will consist of female threads on one end and an integral split clamp device on the other end. The clamp device shall have machined grooves that assist axial restraint of the service line. Tightening a stainless-steel clamp screw shall activate the clamp. The Pack Joint nut shall have an internally machined gasket seating location that will constrain a bevelled rubber gasket during compression. A fiber anti-friction ring shall be located between the bevelled rubber gasket and the machined seating location.

The Coppersetter shall exhibit quality design and workmanship throughout. The Double Purpose bottom bar and union swivel, which is functional for flare copper or for iron pipe thread connections, shall be precision machined to provide a watertight brass-to-brass seal without sealants or gaskets.

The HS81-444, 1" Check Valve with 1" male iron pipe thread inlet and 1" female iron pipe thread outlet connections. The check valve shall contain an Acetyl plastic check assembly, which will incorporate an EPDM rubber O-ring for sealing against the internal valve body seat and will include a 302 stainless steel spring. The valve will be capable of withstanding 175 psi working pressure under normal service conditions. The valve will open to allow water flow at approximately three psi. The check valve will be shipped unassembled of the Coppersetter.

The Coppersetter and check valve shall be manufactured by a company that holds a certificate of registration to the International Standards Organization for the ISO 9001-2000 standard. This standard establishes a model for quality assurance in design/development, production, installation, service and customer satisfaction. The manufacturer must certify upon request prior to the bid date that it holds this certificate, as current and in good standing.

The Coppersetter shall be the VVG74-95333-05 Style, as manufactured by the Ford Meter Box Company, Inc.,

Wabash, Indiana or a *pre-approved* equal. All exceptions shall be submitted prior to the bid date.

10.5.1.5 Service tubing shall be one inch (1") diameter 200 psi rated polyethylene tubing suitable for underground water services (blue tubing). Materials shall be supplied in conformance with ASTM D-2737.

10.5.1.6 One inch (1") straight ball valve meter stops shall be bronze body with compression seal inlet connection and threaded outlet for meter connection (compression with locking). Stops shall be Ford BA43-444W, Hayes 252OCJ, A Y McDonald 4602B-22, Mueller P-24258 or approved equal.

10.5.1.7 Service Couplings for 1" water services shall be bronze body with compression seal inlet connections with a stainless-steel set screw. Couplings shall be Ford C44-44, Hayes 5615CJ, A Y McDonald 4758-22, Mueller P-15403, or approved equal.

10.5.1.8 Water meter boxes shall be manufactured of Class 30 cast iron in conformance with ASTM-A48 (latest revision thereof). The manufacturer's name and part number shall be cast into each component and the words "water meter" shall be cast into the cover. Boxes shall be MBX-1. Where meter box has special requirements, owners shall submit request to the Town.

#### 10.5.2 Materials for 1-1/2" and 2" Services

10.5.2.1 Service saddles shall be made of materials conforming to AWWA copper alloy No. C83600 with 2" (NPT) FIP outlet thread and an O-Ring cemented in a confined groove. Service saddles shall be only those listed below.

TYPE MAIN	DIA	APPROVED SADDLE MFS & MOD #
PVC (IPS & Sch 40)	4"-12"	Ford S71 Series, Hayes 527P Series, A Y McDonald Style 3802
ACP/DIP/CIP	4"-12"	Ford Style 202B, A Y McDonald #3826 Mueller BR 2 B Series
PVC (C-900)	4"-12"	Ford S91Series, Hayes 529P Series, Mueller H-13490 through H-13494 Series, A Y McDonald Style 3806

10.5.2.2 Seal gate valves shall be bronze body with two inch nut. The turn required to travel from fully closed to fully open position shall be 90 degrees. Gate valves shall incorporate a check allowing a maximum turn of 90°. Valves shall be Hayes 4300, Ford B11-777 A Y McDonald 6101, Mueller B-20283 or approved equal.

10.5.2.3 Service pipe shall be PVC Class 200 (IPS) conforming to the latest revisions of ASTM D1784 and ASTM D2241. The pipe joints shall be of the integral bell type with rubber gaskets conforming to ASTM D3139 and F477. The pipe shall be SDR 21 and shall bear the National Sanitation Foundation seal for potable water. Fittings shall be schedule 80 PVC with solvent weld joints.

#### 10.5.3 Materials for Services Larger Than 2"

The materials for services larger than 2" shall be identical to those required for water mains.

### 10.6 BACKFLOW PREVENTION ASSEMBLIES

Control assemblies such as reduced pressure principal assemblies, double check valve assemblies and double detector check valve assemblies shall be limited to those approved by the Town and the Foundation for Cross-Connection Control and Hydraulic Research, University of Southern California. Devices shall be utilized where required by Section 18 of the Terms and Conditions.

### 10.7 TAPPING SLEEVES

Tapping sleeves shall be all stainless-steel body and flange with a full circumferential gasket, or ductile iron body, mechanical joint designed to accommodate a minimum operating pressure of 150 pounds per square inch. All tapping sleeves shall be pressure tested prior to tapping the main. Stainless steel tapping sleeves shall be Ford Model FAST, JCM Model 432, Mueller Model H304 or Romac Model SST. Ductile iron body, mechanical joint sleeves shall meet the requirements of Section 7.2.3 of this Manual.

### 10.7.1 Tapping Valves

Tapping valves shall conform to the requirements of the latest revision of AWWA Specification C-509 for resilient- seated gate valves. The valve body shall be ASTM A-126 Class B cast iron. All internal valve parts and surfaces shall be of corrosion resistant materials or have an epoxy coating sufficient to prevent corrosion. Such coating shall be recognized by the AWWA for potable water use. Exterior valve parts and surfaces shall be epoxy coated or have the Standard AWWA coating. The valves shall open counter clockwise and have non-rising stem operation with a two-inch square operating nut. The maximum number of turns required to fully open or close the valve shall equal three times the pipe diameter plus two. The stem shall be of corrosion resistant material and have O-ring seals. Valves shall provide zero leakage at a working pressure of 200 psi in either direction of line flow. Valves shall have a flange connection conforming to ANSI B16.1 Class 125 and a mechanical joint conforming to AWWA C-111. Valves shall be manufactured by Mueller, Clow or American Flow Control. Tapping valves shall be installed and pressure tested prior to tapping the water line.

## 10.8 AIR RELEASE VALVES

Air release valves shall be manually operated valves unless otherwise required by the Town.

### 10.8.1 Manual Air Release Valves

Manual air relief valves shall be of materials identical to those of a one-inch (1") service with the exception that 1) a service saddle or clamp is required (no direct tapping is permitted), and 2) the tap shall be made at the top (crown) of the main.

### 10.8.2 Automatic Air Release Valves

Automatic air release valves shall be small orifice valves designed for the working pressure which will exist in the main at the point of placement. The design and selection of automatic air release valves shall be in accordance with the direction of the Town and shall be handled on a case-by-case basis.

## 10.9 STEEL ENCASEMENT PIPE

- 10.9.1 Steel encasement pipe shall be spiral welded or smooth wall seamless, consisting of grade "B" steel with a minimum yield strength of 35,000 psi and manufactured in accordance with ASTM A139 and A283. The pipe thickness shall be in accordance with the requirements of the right-of-way owner, but in no case less than that shown in the following table. The ends shall be beveled and prepared for field welding at the circumferential joints.

MINIMUM WALL THICKNESS FOR STEEL ENCASEMENT PIPE

Nominal Diameter in inches	Minimum Thickness in inches
4-12 3/4	0.188
14	0.219
16-18	0.250
20	0.281
22	0.312
24	0.344
26	0.375
28-30	0.406
32	0.438
34-36	0.469
38-42	0.500

- 10.9.2 The encasement pipe shall be uncoated inside and out unless required otherwise by the right-of-way owner or the Town.
- 10.9.3 Encasement pipe and joints shall be of leak proof construction, capable of withstanding design loading. The inside diameter of the encasement pipe shall be at least 2 inches greater than the largest outside diameter of the carrier pipe, joints or couplings, for carrier pipe less than 6 inches in diameter; and at least 4 inches greater for carrier pipe 6 inches and larger in diameter. In general, to determine the casing size you should double the size of the carrier pipe, i.e., a 6" carrier pipe requires a 12" casing pipe. The engineer shall verify the clearance is sufficient to allow the carrier pipe to be removed without disturbing the casing pipe.



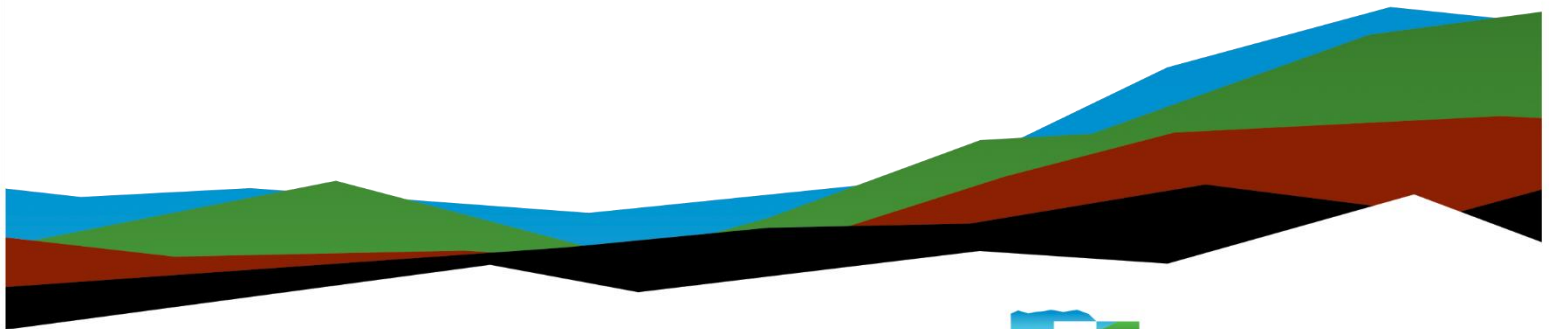
# NC Maritime Museum

## Geotechnical Engineering Report

August 1, 2023 | Terracon Project No. K6235038

### Prepared for:

The Maritime Heritage Foundation  
of Beaufort, NC, Inc.  
PO Box 685, 403 Ann Street  
Beaufort, NC 28516



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August 1, 2023

The Maritime Heritage Foundation of Beaufort, NC, Inc.  
PO Box 685, 403 Ann Street  
Beaufort, NC 28516

c/o: Mr. Allan Kram – Clark Nexsen

Attn: Mr. Leonard Y. Safrit, c/o Lisa Cox  
P: (252) 728-7654

Re: Geotechnical Engineering Report  
NC Maritime Museum  
239 West Beaufort Road Extension  
Beaufort, North Carolina  
Terracon Project No. K6235038

Dear Mr. Safrit:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. PK6235038R1 dated June 15, 2023. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, floor slabs, retaining walls, and pavements for the proposed project. We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

**Terracon**

Mike Delaney, P.E.  
Senior Staff Engineer



Justin L. Delaney, P.E.  
Office Manager  
Registered, NC 046129

APR Review: Andrew A. Nash, P.E.

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GeoModel


## Attachments

**Exploration and Testing Procedures**

**Site Location and Exploration Plans**

**Exploration and Laboratory Results**

**Supporting Information**

**Note:** This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  Terracon logo will bring you back to this page. For more interactive features, please view your project online at [client.terracon.com](https://client.terracon.com).

Refer to each individual Attachment for a listing of contents.

## Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed NC Maritime Museum to be located at 239 West Beaufort Road Extension in Beaufort, North Carolina. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Seismic site classification per NCSBC
- Site preparation and earthwork
- Demolition considerations
- Dewatering considerations
- Foundation design and construction
- Floor slab design and construction
- Lateral earth pressures
- Pavement subgrade support parameters

The geotechnical engineering Scope of Services for this project included the advancement of electronic Cone Penetration Test (CPT) soundings, macrocore sampling, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown in the [Site Location](#) and [Exploration Plan](#) sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs and as separate graphs in the [Exploration and Laboratory Results](#) section.

## Project Description

Our final understanding of the project conditions is as follows:

Item	Description
<b>Information Provided</b>	<p>Project information was obtained via email correspondence between Terracon and Clark Nexsen on April 3, 2023. The correspondence contained a summary of the project and a master plan document prepared by Clark Nexsen.</p> <p>We were provided with a preliminary grading plan prepared by Withers Ravenel and requested boring location plan on June 8, 2023.</p>
<b>Project Description</b>	Plans for the first phase of the project include redeveloping the site to include a Maritime Museum with associated permeable-paved and gravel-surfaced parking/drives, and sidewalks.
<b>Proposed Structures</b>	We understand the museum will feature two 2-story buildings. The larger building will have a footprint of approximately 4,600 square feet while the smaller building will have a footprint of approximately 1,400 square feet. A pump station is also proposed.
<b>Building Construction</b>	Assumed to be metal or wood framed with slab on grade construction. Foundations are anticipated to consist of shallow foundations after surcharge loading.
<b>Finished Floor Elevation</b>	Based on the provided preliminary grading plan, the finished floor elevation of the buildings and pump station is anticipated to be 12 feet.
<b>Maximum Loads</b>	<p>Based on our experience with similar projects and preliminary information provided by the design team we have assumed the following structural loading information:</p> <ul style="list-style-type: none"> <li>■ Columns: up to 50 kips</li> <li>■ Walls: up to 6 kips per linear foot (klf)</li> <li>■ Slabs: 100 pounds per square foot (psf)</li> </ul>
<b>Grading/Slopes</b>	Based on the provided preliminary grading plan, up to 8 feet of fill will be required to develop final grade, excluding any remedial grading requirements.
<b>Below-Grade Structures</b>	None
<b>Free-Standing Retaining Walls</b>	Retaining walls are proposed along the northern and southern sides of the building with heights of up to 8 feet. The type of wall has not been determined.

Item	Description
<b>Pavements</b>	We assume both rigid (concrete) and flexible (asphalt) pavement sections will be used, and understand that permeable pavement sections will be used, as well.
<b>Building Code</b>	2018 North Carolina State Building Code
<b>Stormwater Control Measures</b>	Permeable pavements, to be designed by others

Terracon should be notified if any of the above information is inconsistent with the planned construction, especially the grading and structural loading information, as modifications to our recommendations may be necessary.

## Site Conditions

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
<b>Parcel Information</b>	The site is located at 239 West Beaufort Road Extension in Beaufort, North Carolina. Carteret County Parcel ID No. (PIN): 730613140379000 Coordinates Latitude/Longitude: 34.7281°N, 76.6667 °W (approximate) See <a href="#">Site Location</a>
<b>Existing Improvements</b>	The existing Gallants Channel site features a gravel parking area, docks, access roads and structures associated with the Junior Sailing Program and Bonehenge Whale Center.
<b>Current Ground Cover</b>	Asphalt, gravel and grassed areas. The northern portion of the site is lightly- to moderately-vegetated.
<b>Existing Topography</b>	Based on the provided grading plan, the site is relatively flat at an elevation of 5 to 6 feet MSL.

## Geotechnical Characterization

### Geology

The project site is located in the Coastal Plain Physiographic Province. The Coastal Plain soils consist mainly of marine sediments that were deposited during successive periods

of fluctuating sea level and moving shoreline. The soils include sands, silts, and clays with irregular deposits of shells, which are typical of those laid down in a shallow sloping sea bottom. Recent alluvial sands, silts, and clays are typically present near rivers and creeks.

According to USGS Mineral Resources On-Line Spatial Data based on the 1998 digital equivalent of the 1985 Geologic Map of North Carolina, the site is mapped within the Surficial Deposits, Undivided (Quaternary).

## Soil Profile

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the [Exploration Results](#) and the GeoModel can be found in the [Figures](#) attachment of this report. Surficial materials are not included in the GeoModel.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the [GeoModel](#).

Model Layer	Layer Name	General Description
1	Existing Fill <sup>1</sup>	Sand with varying amounts of silt, rock fragments, and wooden debris
2	Sand	Sand with varying amounts of silt, clay, and shell fragments; interbedded clay lenses; very loose to dense
3	Loose Sand and Soft Clay	Silty and clayey sand and sandy lean clay; saturated; interbedded seams of sand and shell fragments; very loose to loose; very soft to soft

1. We anticipate that the existing fill material encountered in our exploration was placed with grading operations during the original development of the site. Based on CPT tip resistances greater than 50 tsf, the fill appears to have been placed in a controlled manner, but we have no records indicating the degree of control.

## Groundwater Conditions

Based on the measured water levels during exploration, cave in depths, CPT data, and moisture condition of the soil samples, groundwater is anticipated at depths ranging from 1 foot to 5 feet below the existing ground surface across the site.



Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, the tidal, and other factors not evident at the time the soundings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

## SHWT and Infiltration Testing

The seasonal high water table (SHWT) evaluation and infiltration testing results determined are indicated in the table below. Please refer to the attached Stormwater Soil Evaluations report in [Supporting Information](#) for information regarding the observed SHWT depths and the associated impact on the grading plan and grading operations in areas of permeable pavements.

Location	Infiltration Rate (in/hr)	Testing Interval (inches) <sup>1</sup>	SHWT Depth (inches) <sup>1</sup>	Observed Water Depth (inches) <sup>1, 2</sup>
P-01	1.36	2 to 8	8	24
P-02	0.57	2 to 8	6	22
P-03	0.60	1 to 7	8	36
P-04	0.60	1 to 7	3	30
P-05	0.51	2 to 8	4	12
P-06	0.70	2 to 8	7	24

1. Referenced from existing ground surface

2. Shallowest observation between CPT soundings and hand auger borings

## Seismic Site Class

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7-10 and the North Carolina Building Code (NCSBC). Based on the soil properties observed at the site and as described on the exploration logs and results, our professional opinion is for that a **Seismic Site Classification of D** be considered for the project. Subsurface explorations at this site were extended to a maximum depth of 56 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area.



## Liquefaction

Liquefaction occurs when a rapid buildup in water pressure, caused by ground motion, pushes sand particles apart, resulting in a loss of strength and later densification as the water pressure dissipates. This loss of strength can cause bearing capacity failure while the densification can cause excessive settlement.

The amount of settlement is dependent on the magnitude and distance from a seismic event, and geologic age of the soil deposit. Based on the relatively mild ground motions associated with the design earthquake the potential for liquefaction is negligible at this site.

## Geotechnical Overview

Based upon the geotechnical conditions encountered in our exploration, the site generally appears suitable for the proposed construction, provided that the recommendations given herein are implemented in the design and construction phases of this project. Our recommendations rolling the subgrade, remediation of soils that are not improved during earthwork, and the implementation of a settlement monitoring program in structural areas to receive more than 5 feet of fill. Subsurface conditions at the site included very loose to dense sand, very soft to soft clay, and groundwater within 1 foot to 5 feet of the ground surface. Earthwork operations should be performed during the warmer, drier periods of the year (May through October) to avoid problems associated with a wet subgrade.

Based on the debris observed within the existing fill material encountered at the site, we recommend evaluating by test pit excavations and proofrolling. If large amounts of debris are encountered, we recommend removing this material and replacing with structural fill. The excavated material can be evaluated for reuse as structural fill at that time.

Based on the provided grading information, 6 feet to 8 feet of fill will be placed within the footprint of the proposed buildings and pump station. We anticipate that this will induce 1-inch to 2-inches of settlement on the underlying soils. Following fill placement, foundation construction should be delayed until settlement has sufficiently diminished, as directed by the geotechnical engineer. Further details are provided in [Settlement Monitoring](#).

Based on CPT tip resistances less than 10 tsf encountered within the near-surface (upper 4 feet) of locations P-02, P-06, P-07, P-10, P-11, and P-12, we anticipate that these soils may not withstand proofrolling and will require remedial grading as discussed in [Earthwork](#).

The groundwater table could affect overexcavation efforts, especially for overexcavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps may be necessary to achieve the recommended depth of overexcavation depending on groundwater conditions at the time of construction. Backfill consisting of AASHTO size No. 57 stone wrapped in geotextile fabric is often most suitable for overexcavation depths exceeding that of the water table.

Following the recommended **Earthwork** and completion of the settlement monitoring program, the building can be supported on shallow foundations bearing on approved existing soils or structural fill compacted as recommended and sized for a maximum net allowable soil bearing pressure of 2,000 psf. The **Shallow Foundations** section addresses support of the building bearing on densified existing fill soils or structural fill. The **Floor Slabs** section addresses slab-on-grade support of the building.

A rigid or flexible pavement system, or gravel-surfaced drive, is suitable for this site. The **Pavements** section addresses the design of pavement systems supported on the densified existing soils or structural fill. Please refer to the attached Stormwater Soil Evaluations report in **Supporting Information** for the impact that the observed depth to SHWT will have on the proposed grading plan in areas of permeable pavements.

The **General Comments** section provides an understanding of the report limitations.

## Earthwork

Earthwork is anticipated to include demolition, clearing and grubbing, excavations, and structural fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for foundations, floor slabs, retaining walls, and pavements.

### Demolition

Site preparation should begin with the demolition of the existing structures/pavements and debris removal. As part of the demolition, buried utilities and/or concrete foundations should also be removed. Existing utilities that are to be abandoned should be removed or filled with grout. The excavations resulting from foundation and utility removal should be properly backfilled with compacted structural fill as described in the following subsections. Utilities that are to remain in service should be accurately located horizontally and vertically to minimize conflict with new foundation construction.

## Site Preparation

Prior to placing fill, existing vegetation, topsoil, and root mats should be removed. Based on the results of our exploration, topsoil thickness measurements ranged from approximately 2 to 8 inches. Complete stripping of the topsoil should be performed in the proposed building and parking/driveway areas.

Based on the debris observed within the existing fill material encountered at the site, we recommend evaluating by test pit excavations and proofrolling. If large amounts of debris are encountered, we recommend removing this material and replacing with structural fill. The excavated material can be evaluated for reuse as structural fill at that time.

Although no evidence of underground facilities (such as septic tanks, cesspools, basements, and utilities) was observed during the exploration and site reconnaissance, such features could be encountered during construction. If unexpected underground facilities are encountered, such features should be removed, and the excavation thoroughly cleaned prior to backfill placement and/or construction.

## Subgrade Preparation

After stripping and removing topsoil and debris and once any areas of cut have been excavated to proposed subgrade elevation, the exposed subgrade soils in the building and pavement footprints should be densified in place using a medium weight vibratory roller. The purpose of the vibratory rolling is to densify the exposed subgrade soils for floor slab and pavement support and to potentially improve the foundation bearing soils. The roller should make at least six passes across the site, with the second set of three passes perpendicular to the first set of three passes with intermittent vibration activated. If water is brought to the surface by the vibratory rolling, the operation should be discontinued until the water subsides. Vibratory rolling should be completed during dry weather. Static rolling and additional repairs should be anticipated for areas too wet for vibratory rolling.

After the vibratory rolling, pore pressures should be allowed to dissipate for a minimum of 16 hours. After the waiting period, proofrolling should be performed on the exposed subgrade soils in areas to receive fill or at the subgrade elevation with a loaded, tandem-axle dump truck (15 to 20 ton total vehicle weight) or similar rubber-tired construction equipment. Proofrolling is recommended as a means of detecting areas of soft or unstable subgrade soils. The proofrolling should be performed during a period of dry weather to avoid degrading an otherwise suitable subgrade. The proofrolling operations should be observed by a representative of the geotechnical engineer. Subgrade soils that exhibit excessive rutting or deflection during proofrolling should be repaired as directed by the field representative. Typical repairs include overexcavation

followed by replacement with either properly compacted fill or by a subgrade stabilization fabric in conjunction with a sand fill or crushed stone.

As previously mentioned, the near-surface soils encountered at locations P-02, P-06, P-07, P-10, P-11, and P-12 exhibit CPT tip resistances less than 10 tsf. If these soils do not improve with vibratory densification and withstand proofrolling they will require remedial grading as discussed below.

If subgrade soils are unsuitable, they will require removal and replacement; however, if they are unstable due to excessive moisture, the most economical solution for remediation may be to scarify, dry and recompact the material. This remediation is most effective during the typically hotter months of the year (May to October). If construction is performed during the cooler period of the year, the timeline for scarifying, drying, and recompacting typically increases considerably and may lead to alternative remediation solutions. These solutions can include overexcavation of some or all of the unstable material to be backfilled with either approved structural fill or geotextile and ABC Stone. Potential undercutting can be reduced if the site preparation work is performed during a period of dry weather and if construction traffic is kept to a minimum on prepared subgrades. We recommend that the contractor submit a unit rate cost for undercutting as part of the bidding process.

## Existing Fill

As noted in [Geotechnical Characterization](#), existing fill soils were encountered in the upper 1 foot to 3 feet of locations B-01, B-04, B-05, B-06, B-08, P-02, P-03, and P-07. Based on the debris observed within the existing fill material encountered at the site, we recommend evaluating by test pit excavations and proofrolling. If large amounts of debris are encountered, we recommend removing this material and replacing with structural fill. The excavated material can be evaluated for reuse as structural fill at that time.

The fill appears to be placed in a controlled manner (with the exception of the previously identified fill materials that contained debris) but we have no records to indicate the degree of control. Support of floor slabs and pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction procedures, inherent risk exists for the owner that compressible fill or unsuitable material, within or buried by the fill will, not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill but can be reduced by following the recommendations contained in this report.

If the owner elects to construct the foundations, floor slabs, and pavements on the existing fill to reduce initial construction costs in exchange for increased potential longer-term distress, the following protocol should be followed prior to placing fill. Once any areas of cut are excavated to proposed subgrade elevation and after vibratory densification, the entire area should be proofrolled with heavy, rubber tire construction

equipment, to aid in delineating areas of soft or otherwise unsuitable soil. Once unsuitable materials have been remediated and the subgrade has passed the proofroll test, the existing fill soils that were removed can be evaluated for reuse as structural fill.

## Settlement Monitoring

Based on the provided grading information and the results of our exploration, we anticipate approximately 2 inches of settlement of the underlying soils will occur under the weight of the proposed fill to reach design grades in the building and pump station areas. We recommend a settlement monitoring program be implemented as described below. Continued construction of settlement sensitive structures (foundations, floor slabs, and pavements) should be postponed until settlement of the underlying soils have substantially ceased.

After site preparation, settlement plates should be installed prior to placing fill in the building pads and pump station areas and initial readings should be taken by the project surveyor. Readings should be taken twice a week and recorded to the nearest 100th of a foot. We anticipated settlements will substantially cease after a period of 30 days. After the settlement has substantially ceased as determined by the Geotechnical Engineer, the foundation construction can commence. A typical settlement plate detail is presented in [Supporting Information](#). We recommend a minimum of four settlement plates be installed, equally spaced across the building pads and one installed at the pump station area.

## Excavation

We anticipate that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. The bottom of excavations should be thoroughly cleaned of loose soils and disturbed materials prior to backfill placement and/or continued construction.

## Fill Material Types

Earthen materials used for structural fill should meet the following material property requirements:

Soil Type <sup>1</sup>	USCS Classification	Acceptable Location for Placement
Imported Soil	SC, SM, SP, SP-SM, SC-SM	All locations and elevations

Soil Type <sup>1</sup>	USCS Classification	Acceptable Location for Placement
On-Site Soils	SP, SM, SC (LL<50 or PI<20)	All locations and elevations

1. Structural fill should consist of approved materials free of organic matter and debris. Frozen materials should not be used, and fill should not be placed on frozen subgrade. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.

Fine-grained soils such as clays and silts should not be reused as structural fill due to their moisture sensitivity when compared to the sandier soils available on site. Reuse of SC material could lead to delays in construction depending on moisture conditions at the site.

## Fill Placement and Compaction Requirements

Structural and general fill should meet the following compaction requirements.

Item	Structural Fill	General Fill
<b>Maximum Lift Thickness</b>	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used	Same as structural fill
<b>Minimum Compaction Requirements</b> <sup>1,2,3</sup>	95% of maximum 98% within one foot of finished subgrade	92% of max.
<b>Water Content Range</b> <sup>1, 3</sup>	Within 2 percent of optimum moisture content	As required to achieve min. compaction requirements

Item	Structural Fill	General Fill
	<ol style="list-style-type: none"> <li>1. Fill should be tested for moisture content and compaction during placement. If in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the tests should be reworked and retested as required until the specified moisture and compaction requirements are achieved.</li> <li>2. It is not necessary to achieve 95% compaction on the existing ground prior to placing fill or beginning construction. However, the subgrade should be evaluated by the Geotechnical Engineer prior to placing fill or beginning construction.</li> <li>3. Maximum density and optimum water content as determined by the standard Proctor test (ASTM D 698).</li> <li>4. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D 4253 and D 4254). Materials not amenable to density testing should be placed and compacted to a stable condition observed by the Geotechnical Engineer or representative.</li> </ol>	

## Utility Trench Backfill

Any soft or unsuitable materials encountered at the bottom of utility trench excavations should be removed and replaced with structural fill or bedding material in accordance with public works specifications for the utility being supported. This recommendation is particularly applicable to utility work requiring grade control and/or in areas where subsequent grade raising could cause settlement in the subgrade supporting the utility. Trench excavation should not be conducted below a downward 1:1 projection from existing foundations without engineering review of shoring requirements and geotechnical observation during construction.

Trench backfill should be mechanically placed and compacted as discussed earlier in this report. Compaction of initial lifts should be accomplished with hand-operated tampers or other lightweight compactors. Where trenches are placed beneath slabs or footings, the backfill should satisfy the material requirements of engineered fill discussed in this report. Flooding or jetting for placement and compaction of backfill is not recommended.

## Grading and Drainage

All grades must provide effective drainage away from the building during and after construction and should be maintained throughout the life of the structure. Water retained next to the building can result in soil movements greater than those discussed in this report. Greater movements can result in unacceptable differential floor slab and/or foundation movements, cracked slabs and walls, and roof leaks. The roof should have gutters/drains with downspouts that discharge onto splash blocks at a distance of at least 10 feet from the building.

Exposed ground should be sloped and maintained at a minimum 5% away from the building for at least 10 feet beyond the perimeter of the building. Locally, flatter grades may be necessary to transition ADA access requirements for flatwork. After building construction and landscaping have been completed, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted, as necessary, as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration.

## Earthwork Construction Considerations

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Earthwork operations should be performed during the warmer, drier periods of the year (May through October) to avoid problems associated with a wet subgrade.

Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of grade-supported improvements such as floor slabs and pavements. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over or adjacent to construction areas should be removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompact prior to floor slab construction.

The groundwater table could affect overexcavation efforts, especially for overexcavation and replacement of lower strength soils. A temporary dewatering system consisting of sumps with pumps may be necessary to achieve the recommended depth of overexcavation depending on groundwater conditions at the time of construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Excavations or other activities resulting in ground disturbance have the potential to affect adjoining properties and structures. Our scope of services does not include review of available final grading information or consider potential temporary grading performed



by the contractor for potential effects such as ground movement beyond the project limits. A preconstruction/ precondition survey should be conducted to document nearby property/infrastructure prior to any site development activity. Excavation or ground disturbance activities adjacent or near property lines should be monitored or instrumented for potential ground movements that could negatively affect adjoining property and/or structures.

## Construction Observation and Testing

The earthwork efforts should be observed by the Geotechnical Engineer (or others under their direction). Observation should include documentation of adequate removal of surficial materials (vegetation, topsoil, and pavements), evaluation and remediation of existing fill materials, as well as proofrolling and mitigation of unsuitable areas delineated by the proofroll.

Each lift of compacted fill should be tested, evaluated, and reworked, as necessary, as recommended by the Geotechnical Engineer prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in the building areas and 5,000 square feet in pavement areas. Where not specified by local ordinance, one density and water content test should be performed for every 100 linear feet of compacted utility trench backfill and a minimum of one test performed for every 12 vertical inches of compacted backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated by the Geotechnical Engineer. The bottom of footings should be checked with hand augers and Dynamic Cone Penetrometer (DCP) testing that extend through any existing fill material. If unanticipated conditions are observed, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer's evaluation of subsurface conditions, including assessing variations and associated design changes.

## Shallow Foundations

If the site has been prepared in accordance with the requirements noted in [Earthwork](#) and the settlement monitoring program has been completed, the following design parameters are applicable for shallow foundations.

## Design Parameters – Compressive Loads

Item	Description
<b>Maximum Net Allowable Bearing Pressure</b> <sup>1, 2</sup>	2,000 psf
<b>Required Bearing Stratum</b> <sup>3</sup>	Approved existing soils or structural fill
<b>Minimum Foundation Dimensions</b>	Per NC Building Code: Columns: 24 inches Continuous: 16 inches
<b>Sliding Resistance</b> <sup>4</sup>	0.3 ultimate coefficient of friction - granular material
<b>Minimum Embedment below Finished Grade</b> <sup>5</sup>	Exterior footings in unheated areas: 18 inches Exterior footings in heated areas: 18 inches Interior footings in heated areas: 12 inches
<b>Estimated Total Settlement from Structural Loads</b> <sup>2</sup>	Less than about 1 inch <sup>7</sup>
<b>Estimated Differential Settlement</b> <sup>2, 6</sup>	About 1/2 of total settlement <sup>7</sup>

1. The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Values assume that exterior grades are no steeper than 20% within 10 feet of structure. The maximum net allowable bearing pressure may be increased by 1/3 for transient wind loads and seismic loads.
2. Values provided are for maximum loads noted in [Project Description](#). Additional geotechnical consultation will be necessary if higher loads are anticipated.
3. Unsuitable or soft soils should be overexcavated and replaced per the recommendations presented in [Earthwork](#).
4. Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Frictional resistance for granular materials is dependent on the bearing pressure which may vary due to load combinations. For fine-grained materials, lateral resistance using cohesion should not exceed ½ the dead load.
5. Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
6. Differential settlements are noted for equivalent-loaded foundations and bearing elevation as measured over a span of 50 feet.
7. Following the required preload duration

## Design Parameters – Overturning and Uplift Loads

Shallow foundations subjected to overturning loads should be proportioned such that the resultant eccentricity is maintained in the center-third of the foundation (e.g.,  $e < b/6$ ,

where  $b$  is the foundation width). This requirement is intended to keep the entire foundation area in compression during the extreme lateral/overturning load event. Foundation oversizing may be required to satisfy this condition.

Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils with consideration to the IBC basic load combinations.

Item	Description
<b>Soil Moist Unit Weight</b>	110 pcf
<b>Soil Effective Unit Weight<sup>1</sup></b>	48 pcf
<b>Soil weight included in uplift resistance</b>	Soil included within the prism extending up from the top perimeter of the footing at an angle of 20 degrees from vertical to ground surface

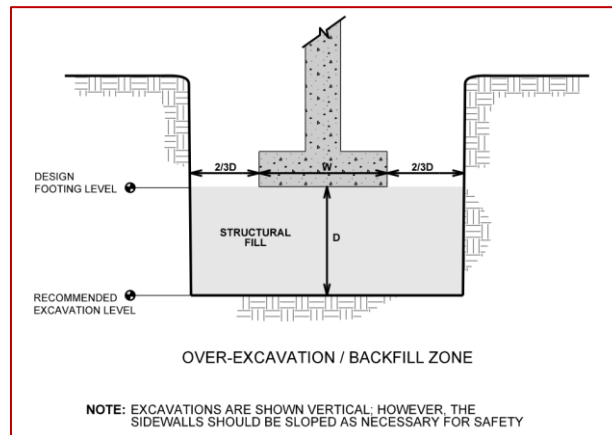
1. Effective (or buoyant) unit weight should be used for soil above the foundation level and below a water level. The high groundwater level should be used in uplift design as applicable.

## Foundation Construction Considerations

The foundation bearing materials should be evaluated at the time of the foundation excavation. This is an essential part of the construction process. A representative of the geotechnical engineer should use a combination of hand auger borings and dynamic cone penetrometer (DCP) testing to determine the suitability of the bearing materials for the design bearing pressure. DCP testing should be performed to a depth of 3 to 5 feet below the bottom of foundation excavation and through the existing fill soils. Excessively soft, loose, or wet bearing soils should be over excavated to a depth recommended by the geotechnical engineer. The excavated soils should be replaced with structural fill or washed, crushed stone (NCDOT No. 57) wrapped in a geotextile fabric (Mirafi 140 N or equivalent). The need for the geotextile fabric with the crushed stone should be determined by the Geotechnical Engineer during construction based on sloughing/caving soils and excavation observations. However, footings could bear directly on the soils after over excavation if approved by the Geotechnical Engineer.

The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively disturbed or saturated, the affected soil should be removed prior to placing concrete.

Overexcavation for structural fill placement below footings should be conducted as shown below. The overexcavation should be backfilled up to the footing base elevation, with structural fill placed, as recommended in the [Earthwork](#) section or washed crushed stone (NCDOT No. 57) wrapped in a geotextile fabric.



## Floor Slabs

Design parameters for floor slabs assume the requirements for **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the aggregate base beneath the floor slab.

Existing fill materials were observed at locations B-01, B-04, B-05, B-06, B-08, P-02, P-03, and P-07 extending to depths of 1 foot to 3 feet below existing grade. As previously described, any existing fill present beneath floor slabs should be evaluated by the Geotechnical Engineer as noted in the **Existing Fill** section within **Earthwork**.

### Floor Slab Design Parameters

Item	Description
<b>Floor Slab Support<sup>1</sup></b>	Suitable existing soils or new structural fill compacted in accordance with <b>Earthwork</b> section of this report.
<b>Estimated Modulus of Subgrade Reaction<sup>2</sup></b>	110 pounds per square inch per inch (psi/in) for point loads
<b>Aggregate base course/capillary break<sup>3</sup></b>	Minimum 4 inches of free-draining granular material (less than 5% passing the U.S. No. 200 sieve)

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the

Item	Description
	floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3.	Free-draining granular material should have less than 5% fines (material passing the No. 200 sieve). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, when the project includes humidity-controlled areas, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Saw-cut contraction joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual. Joints or cracks should be sealed with a waterproof, non-extruding compressible compound specifically recommended for heavy duty concrete pavement and wet environments.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means.

Settlement of floor slabs supported on existing fill materials cannot be accurately predicted but could be larger than normal and result in some cracking. Mitigation measures, as noted in **Existing Fill** within **Earthwork**, are critical to the performance of floor slabs. In addition to the mitigation measures, the floor slab can be stiffened by adding steel reinforcement, grade beams, and/or post-tensioned elements.

## Floor Slab Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However, as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of base stone and concrete and corrective action will be required to repair the damaged areas.

Finished subgrade, within and for at least 10 feet beyond the floor slab, should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist

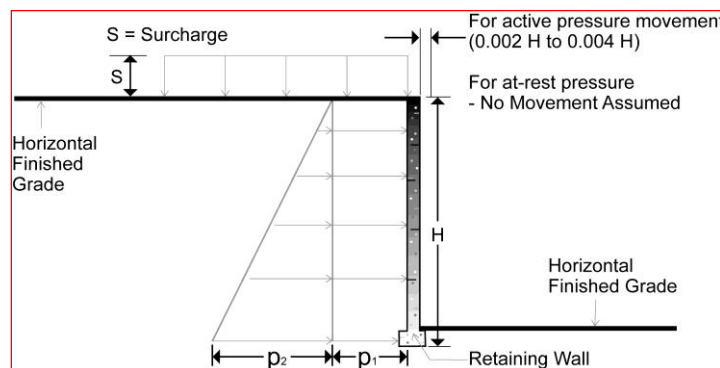
condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed, and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course.

The Geotechnical Engineer should observe the condition of the floor slab subgrades immediately prior to placement of the floor slab support course, reinforcing steel, and concrete. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

## Lateral Earth Pressures

### Design Parameters

Structures with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction, and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown in the diagram below. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated).



### Lateral Earth Pressure Design Parameters

Earth Pressure Condition <sup>1</sup>	Coefficient for Backfill Type <sup>2</sup>	Surcharge Pressure <sup>3</sup> p <sub>1</sub> (psf)	Equivalent Fluid Pressures (psf) <sup>2,4</sup>	
			Unsaturated <sup>5</sup>	Submerged <sup>5</sup>
Active (K <sub>a</sub> )	Granular - 0.31	(0.31)S	(40)H	(80)H
At-Rest (K <sub>o</sub> )	Granular - 0.47	(0.47)S	(55)H	(90)H

1. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance. Fat clay or other expansive soils should not be used as backfill behind the wall.
2. Uniform, horizontal backfill, with a maximum unit weight of 120 pcf.
3. Uniform surcharge, where S is surcharge pressure.
4. Loading from heavy compaction equipment is not included.
5. To achieve "Unsaturated" conditions, follow guidelines in **Subsurface Drainage for Below-Grade Walls** below. "Submerged" conditions are recommended when drainage behind walls is not incorporated into the design.

Backfill placed against structures should consist of granular soils. For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 degrees from vertical for the active case.

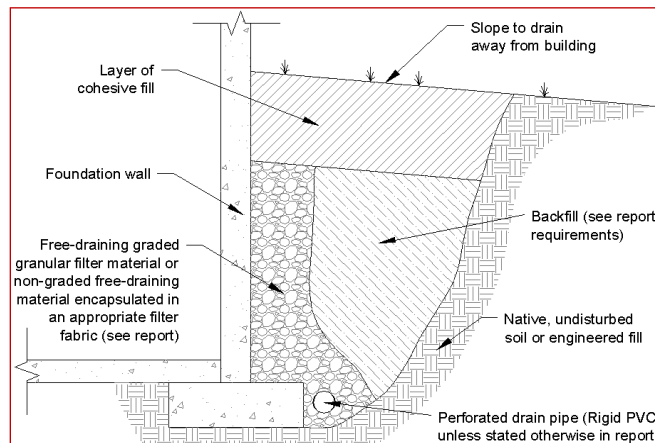
Footings, floor slabs or other loads bearing on backfill behind walls may have a significant influence on the lateral earth pressure. Placing footings within wall backfill and in the zone of active soil influence on the wall should be avoided unless structural analyses indicate the wall can safely withstand the increased pressure.

The lateral earth pressure recommendations given in this section are applicable to the design of rigid retaining walls subject to slight rotation, such as cantilever, or gravity type concrete walls. These recommendations are not applicable to the design of modular block - geogrid reinforced backfill walls (also termed MSE walls). Recommendations covering these types of wall systems are beyond the scope of services for this assignment. However, we would be pleased to develop a proposal for evaluation and design of such wall systems upon request. Additionally, we can provide a global stability analysis of the proposed retaining walls upon request once a wall type and heights have been determined.

### Subsurface Drainage for Below-Grade Walls

A perforated rigid plastic drain line installed behind the base of walls and extends below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around a below-grade building area or exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive

gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 5% passing the No. 200 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a prefabricated drainage structure may be used. A prefabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

## Pavements

### Pavement Subgrade Support Characteristics

Pavement sections can be provided upon receipt of traffic loading information. For pavement design by others, we recommend that a subgrade California Bearing Ratio, CBR, of 9 be used for the asphaltic concrete pavement designs. We recommend that a modulus of subgrade reaction of 110 pci be used for the Portland Cement Concrete (PCC) pavement designs. These values were derived based upon our experience with the sandy subgrade soils, our laboratory testing, and our expectation of the quality of the subgrade as prescribed by the **Site Preparation** conditions as outlined in [Earthwork](#).

Please refer to the attached Stormwater Soil Evaluations report in [Supporting Information](#) for the impact that the observed depth to SHWT will have on the proposed grading plan in areas of permeable pavements.



## General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and

## Geotechnical Engineering Report

NC Maritime Museum | Beaufort, North Carolina  
August 1, 2023 | Terracon Project No. K6235038



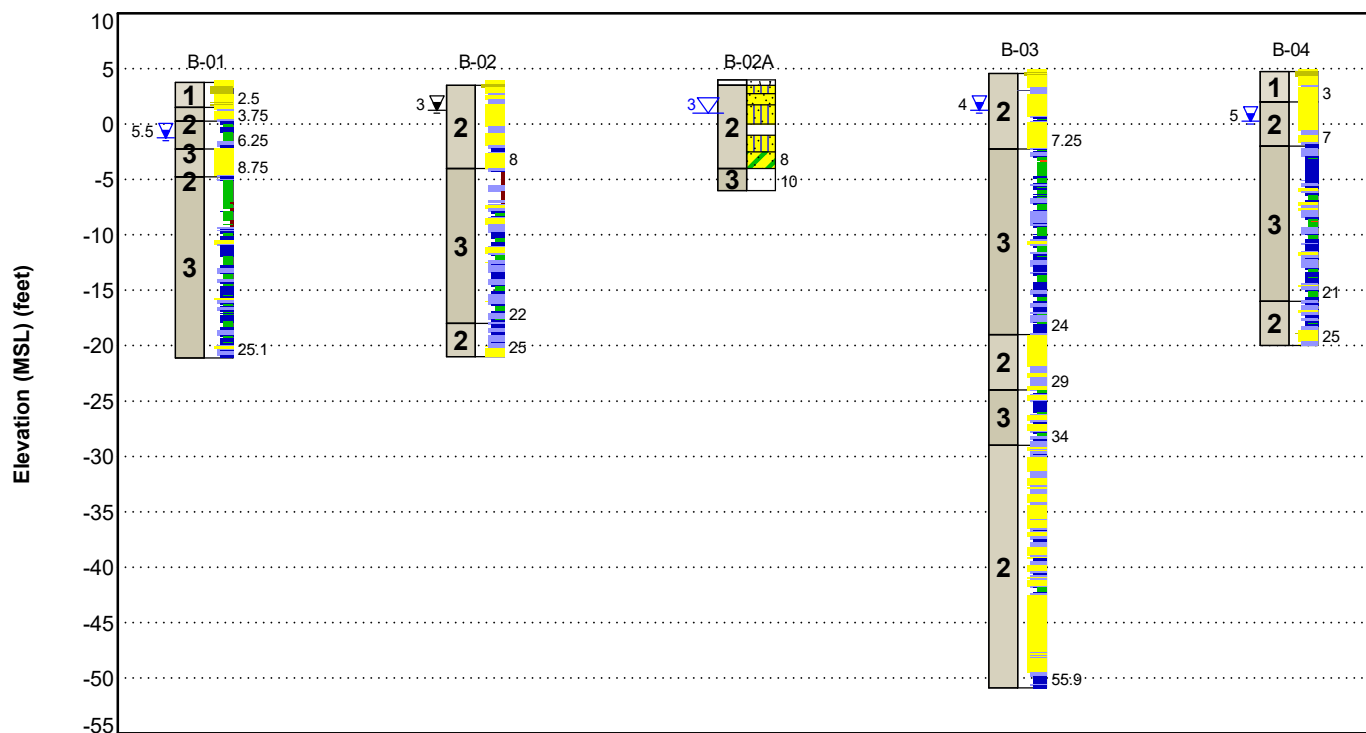
recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

## Figures

### Contents:

- GeoModel (4 pages)
  - Buildings
  - Retaining Wall and Pump Station
  - Permeable Pavements
  - Gravel-Surfaced Parking and Drives

## GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Fill	Sand with varying amounts of silt, rock fragments, and wooden debris
2	Sand	Sand with varying amounts of silt, clay, and shell fragments; interbedded clay lenses; very loose to dense
3	Loose Sand and Soft Clay	Silty and clayey sand and sandy lean clay; saturated; interbedded seams of sand and shell fragments; very loose to loose; very soft to soft

### LEGEND



Topsoil



Silty Sand



Clayey Sand



Poorly-graded Sand

### Soil Behavior Type (SBT)



1 Sensitive, fine grained



2 Organic soils - clay



3 Clay - silty clay to clay



4 Silt mixtures - clayey silt to silty clay



5 Sand mixtures - silty sand to sandy silt



6 Sands - clean sand to silty sand



7 Gravelly sand to dense sand



8 Very stiff sand to clayey sand



9 Very stiff fine grained

▽ CPT Assumed Water Depth

▽ CPT Water Depth

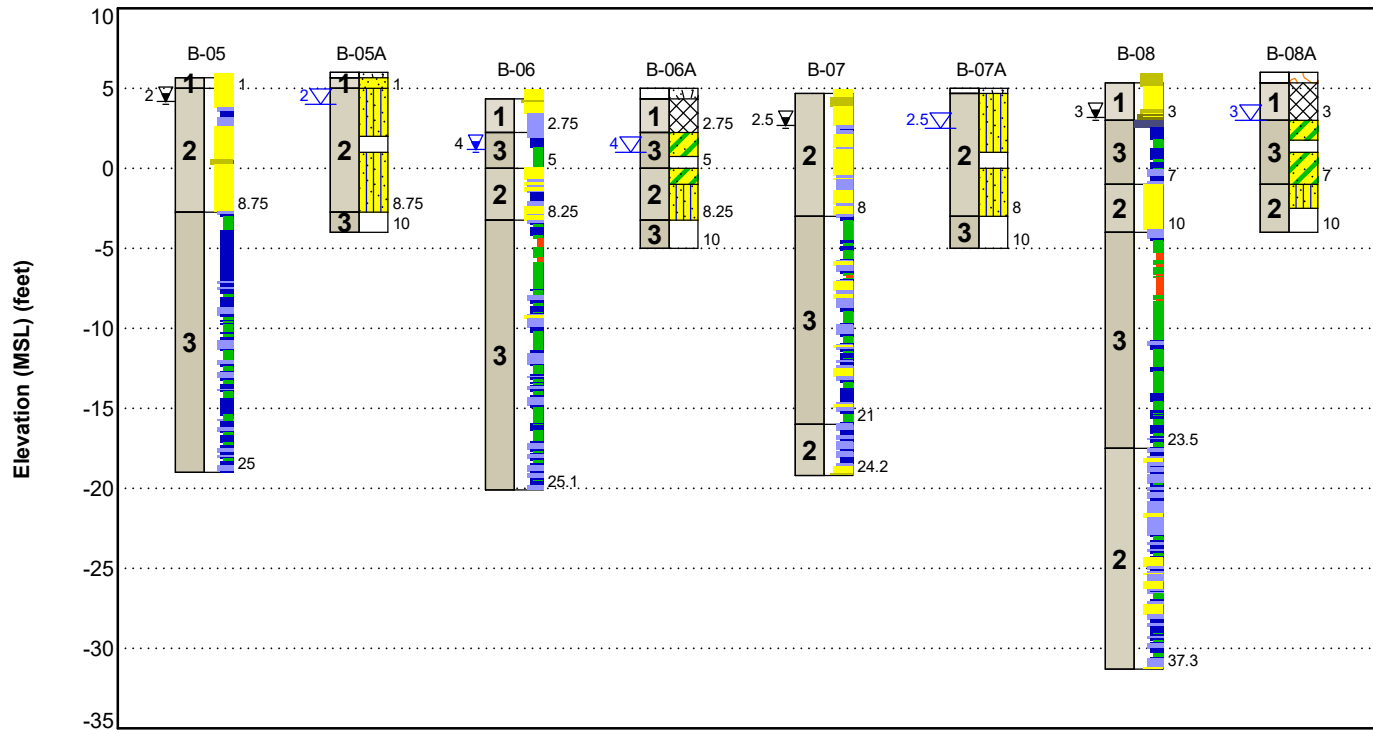
▽ First Water Observation

### NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

## GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Fill	Sand with varying amounts of silt, rock fragments, and wooden debris
2	Sand	Sand with varying amounts of silt, clay, and shell fragments; interbedded clay lenses; very loose to dense
3	Loose Sand and Soft Clay	Silty and clayey sand and sandy lean clay; saturated; interbedded seams of sand and shell fragments; very loose to loose; very soft to soft

### LEGEND

Topsoil	Well-graded Gravel
Poorly-graded Sand	Fill
Silty Sand	Clayey Sand

### Soil Behavior Type (SBT)

1 Sensitive, fine grained	2 Organic soils - clay	3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay	5 Sand mixtures - silty sand to sandy silt	6 Sands - clean sand to silty sand
7 Gravely sand to dense sand	8 Very stiff sand to clayey sand	9 Very stiff fine grained

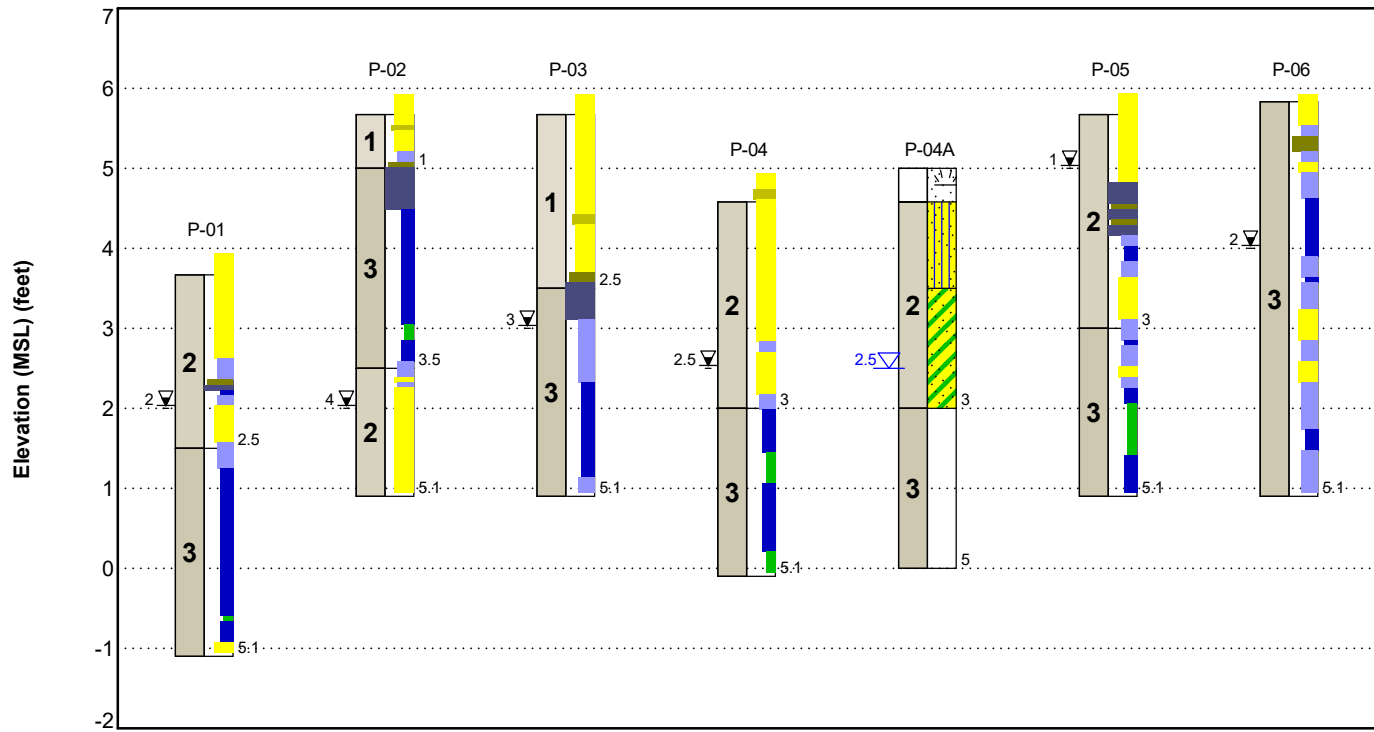
- CPT Assumed Water Depth
- CPT Water Depth
- First Water Observation

### NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

## GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Fill	Sand with varying amounts of silt, rock fragments, and wooden debris
2	Sand	Sand with varying amounts of silt, clay, and shell fragments; interbedded clay lenses; very loose to dense
3	Loose Sand and Soft Clay	Silty and clayey sand and sandy lean clay; saturated; interbedded seams of sand and shell fragments; very loose to loose; very soft to soft

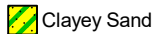
## LEGEND



Topsoil



Silty Sand



Clayey Sand

### Soil Behavior Type (SBT)

1 Sensitive, fine grained

2 Organic soils - clay

3 Clay - silty clay to clay

4 Silt mixtures - clayey silt to silty clay

5 Sand mixtures - silty sand to sandy silt

6 Sands - clean sand to silty sand

7 Gravelly sand to dense sand

8 Very stiff sand to clayey sand

9 Very stiff fine grained

▽ CPT Assumed Water Depth

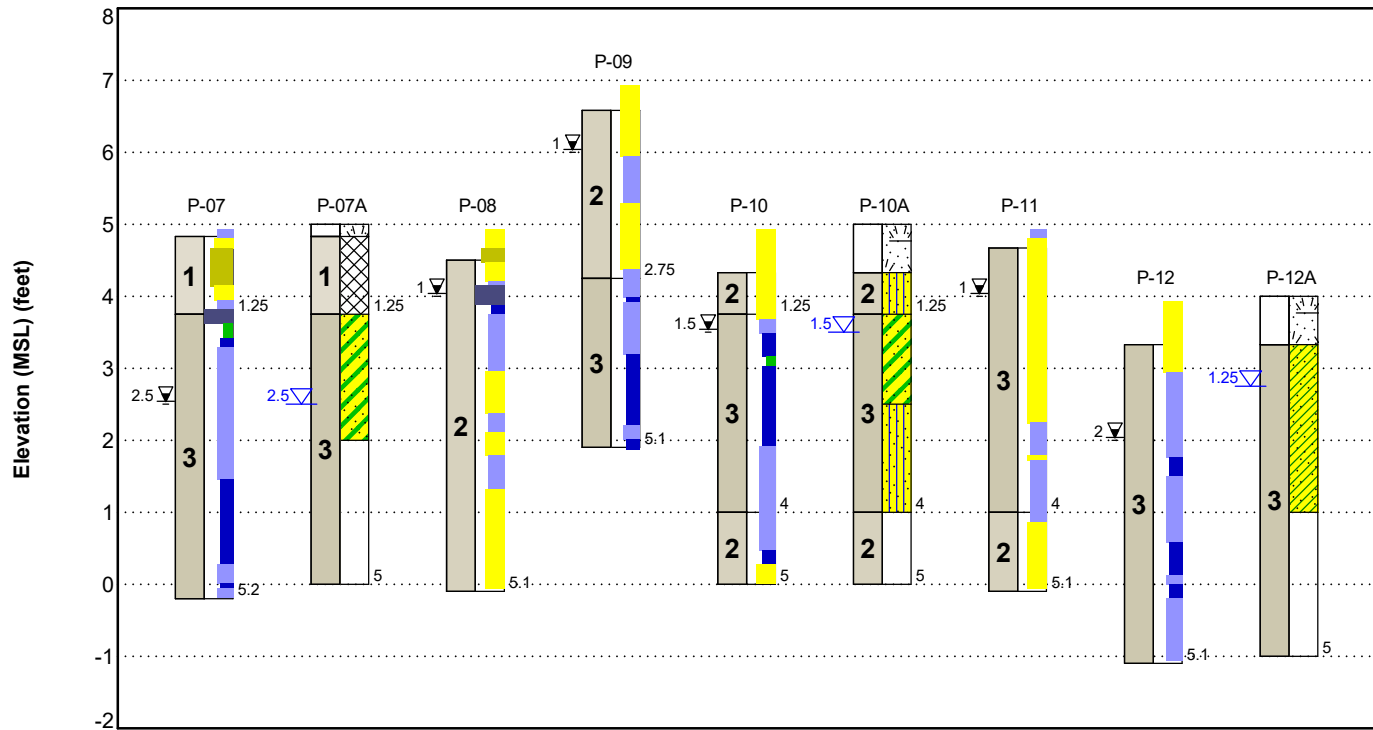
▽ First Water Observation

### NOTES:

Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

## GeoModel



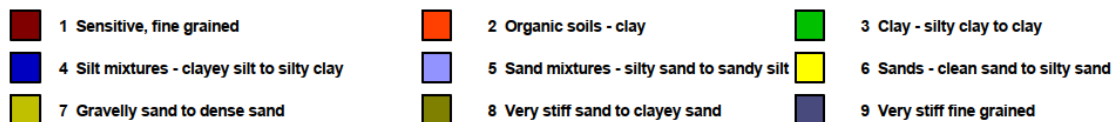
This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Existing Fill	Sand with varying amounts of silt, rock fragments, and wooden debris
2	Sand	Sand with varying amounts of silt, clay, and shell fragments; interbedded clay lenses; very loose to dense
3	Loose Sand and Soft Clay	Silty and clayey sand and sandy lean clay; saturated; interbedded seams of sand and shell fragments; very loose to loose; very soft to soft

## LEGEND



## Soil Behavior Type (SBT)



▽ CPT Assumed Water Depth  
▽ CPT Water Depth  
▽ First Water Observation

**NOTES:**  
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

## Geotechnical Engineering Report

NC Maritime Museum | Beaufort, North Carolina  
August 1, 2023 | Terracon Project No. K6235038



## Attachments



## Exploration and Testing Procedures

### Field Exploration

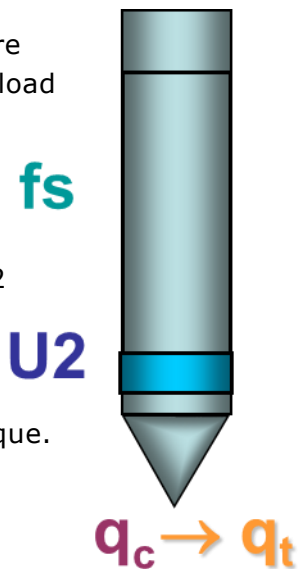
Number of Soundings	Approximate Sounding Depth (feet) <sup>1</sup>	Location
4	25 to 56	Proposed Buildings
3	24 to 25	Proposed Retaining Wall
1	37	Proposed Pump Station
6	5	Proposed Permeable Pavements
6	5	Gravel-Surfaced Parking/Drives

1. Referenced from existing ground surface.

**Exploration Layout and Elevations:** Terracon personnel provided the exploration layout using handheld GPS equipment (estimated horizontal accuracy of about  $\pm 10$  feet) and referencing existing site features. Approximate ground surface elevations were estimated using Google Earth Pro™, as well as the provided grading plan. If elevations and a more precise exploration layout are desired, we recommend our locations be surveyed.

**Subsurface Exploration Procedures:** The subsurface exploration was performed by a track mounted power drilling rig utilizing direct push, cone penetration testing (CPT) to advance into the subsurface. Additionally, nine (9) macrocore sampling tubes were advanced to depths of 5 feet to 10 feet below existing grades to obtain laboratory samples and visually classify near-surface soils. Samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification.

**Cone Penetration Testing (CPT):** The CPT hydraulically pushes an instrumented cone through the soil while nearly continuous readings are recorded to a portable computer. The cone is equipped with electronic load cells to measure tip resistance and sleeve resistance and a pressure transducer to measure the generated ambient pore pressure. The face of the cone has an apex angle of 60° and an area of 10 cm<sup>2</sup>. Digital data representing the tip resistance, friction resistance, pore water pressure, and probe inclination angle are recorded about every 2 centimeters while advancing through the ground at a rate between 1½ and 2½ centimeters per second. These measurements are correlated to various soil properties used for geotechnical design. No soil samples are gathered through this subsurface investigation technique.



CPT testing is conducted in general accordance with ASTM D5778 "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils." Upon completion, the data collected was downloaded and processed by the project engineer.

The SCPT is a modification of the CPT which is used to determine shear wave velocity with depth. This additional information is collected via an accelerometer placed above the instrumented cone. A shear wave is generated at the ground surface, such as a hammer striking a steel plate on the end, which propagates through the soil and is recorded by the accelerometer at selected intervals (typically 1 meter). From this data, the interval shear wave velocities of the soil are calculated. These interval velocities can be used to develop the shear wave velocity profile for the site and can be used to determine a seismic site classification.

The sampling depths, penetration distances, and other sampling information was recorded on the field logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field logs as part of the drilling operations. These field logs included visual classifications of the materials observed during drilling and our interpretation of the subsurface conditions between samples. Final logs were prepared from the field logs. The final logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

## Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Grain-Size Analysis

## Geotechnical Engineering Report

NC Maritime Museum | Beaufort, North Carolina  
August 1, 2023 | Terracon Project No. K6235038



- Atterberg Limits
- Moisture-Density Relationship
- California Bearing Ratio (CBR)

The laboratory testing program often included examination of soil samples by an engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

## Site Location and Exploration Plans

### **Contents:**

Site Location

Exploration Plan

Note: All attachments are one page unless noted above.

## Site Location



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES



Exploration Plan



## **Exploration and Laboratory Results**

### **Contents:**

CPT Sounding Logs (B-01 through B-08, P-01 through P-12)  
Macrocore Logs (B-02A, B-05A through B-08A, P-04A, P-07A, P-10A, P-12A)  
Atterberg Limits  
Moisture-Density Relationship  
California Bearing Ratio (CBR) Test Results

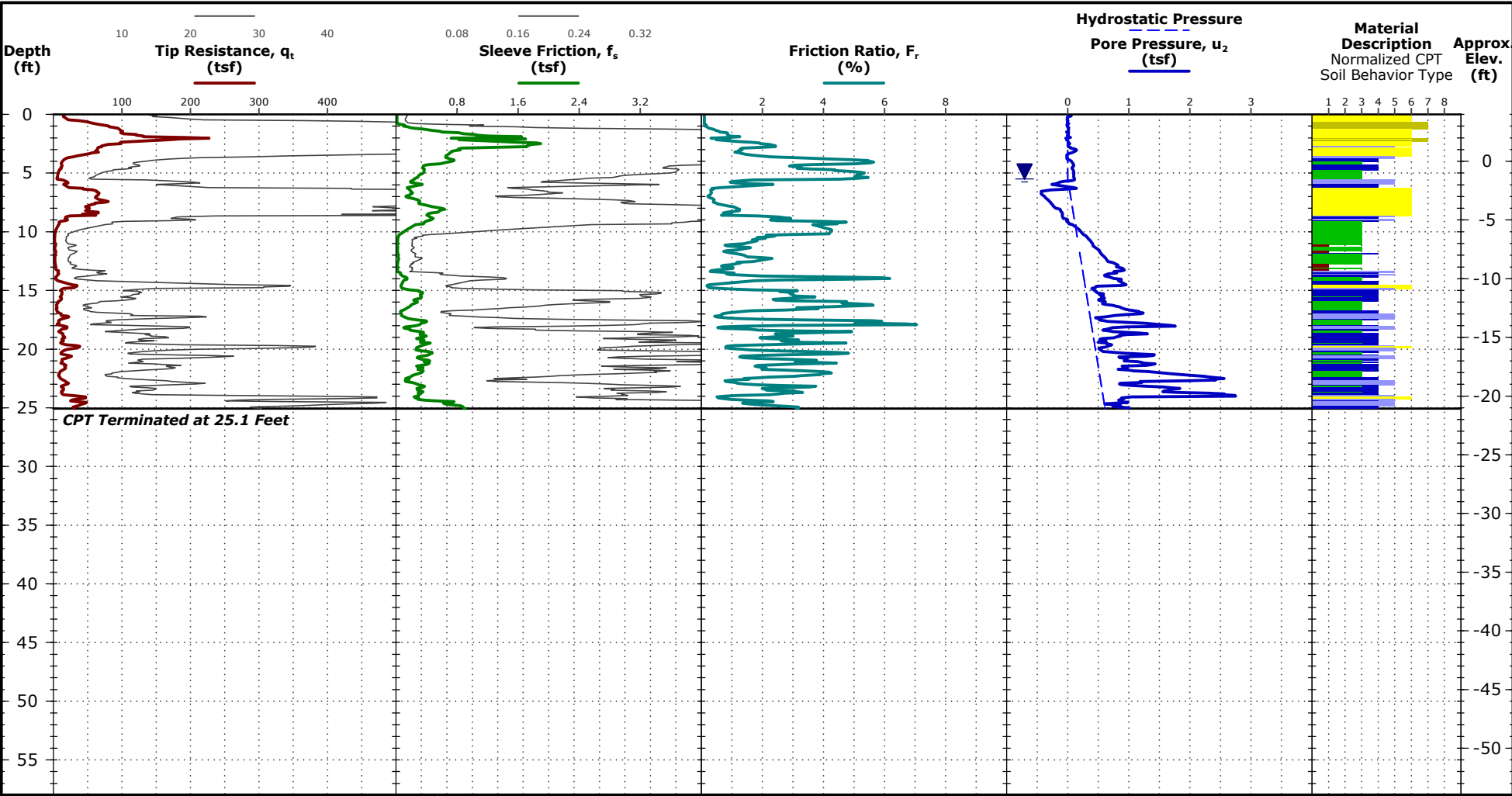
Note: All attachments are one page unless noted above.

# CPT Sounding ID B-01

Elevation: 4 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7282° Longitude: -76.6664°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 3-inches  
Cave-In Depth: 6 feet (wet)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation

5.5 ft measured water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravely sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

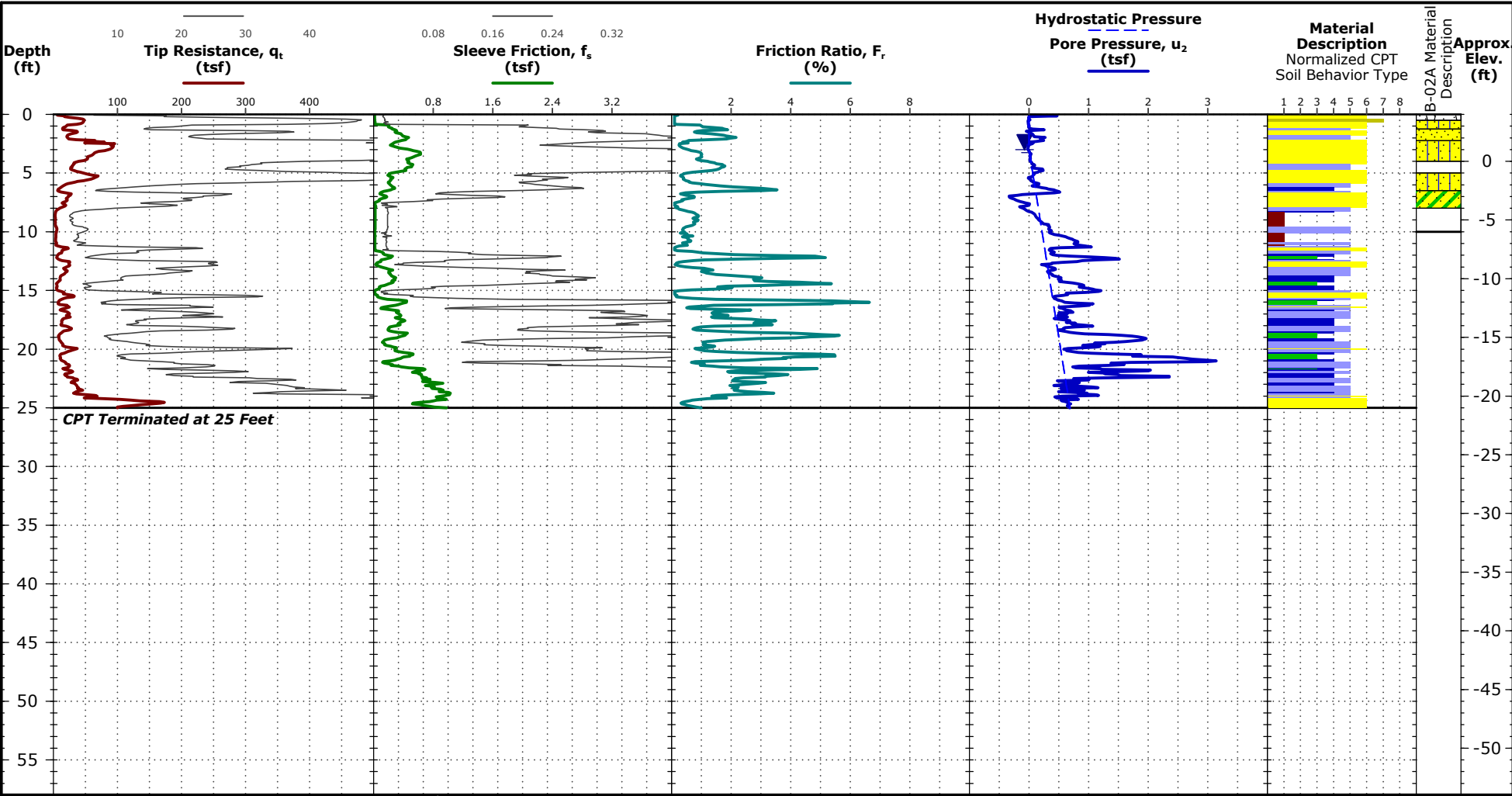


# CPT Sounding ID B-02

Elevation: 4 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7281° Longitude: -76.6666°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
See B-02A for the adjacent test's full details.  
Topsoil Thickness: 6-inches  
Cave-In Depth: 3 feet (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in




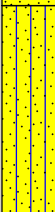

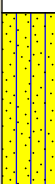

## Water Level Observation

3 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

## Boring Log No. B-02A


Model Layer	Graphic Log	Location: See <a href="#">Exploration Plan</a> Latitude: 34.7281° Longitude: -76.6666°  Depth (Ft.)	Elevation: 4 (Ft.) +/-	Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
								LL-PL-PI	
		<b>TOPSOIL</b> , 6-inches		3.5					
		<b>SILTY SAND (SM)</b> , brown		2.75					
		<b>POORLY GRADED SAND (SP)</b> , tan to gray		1.75					
		<b>SILTY SAND (SM)</b> , gray  Trace shell fragments at 3 feet		0					
2		<b>NO RECOVERY</b>		-1					
		<b>SILTY SAND (SM)</b> , gray		-2.5					
		<b>CLAYEY SAND (SC)</b> , gray		-4					
3		<b>NO RECOVERY</b>		-6					
		<b>Boring Terminated at 10 Feet</b>		10					


See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).  
See [Supporting Information](#) for explanation of symbols and abbreviations.

### Notes

Elevation Reference: Approximate elevations obtained using Google Earth Pro

### Water Level Observations

 Estimated based on cave-in depth and moisture condition of soil samples

 Dry Cave-In

**Advancement Method**  
Direct Push

**Abandonment Method**

**Drill Rig**  
Geoprobe 7822

**Hammer Type**  
N/A

**Driller**  
T. Whitehead

**Logged by**  
M. Delaney

**Boring Started**  
06-19-2023

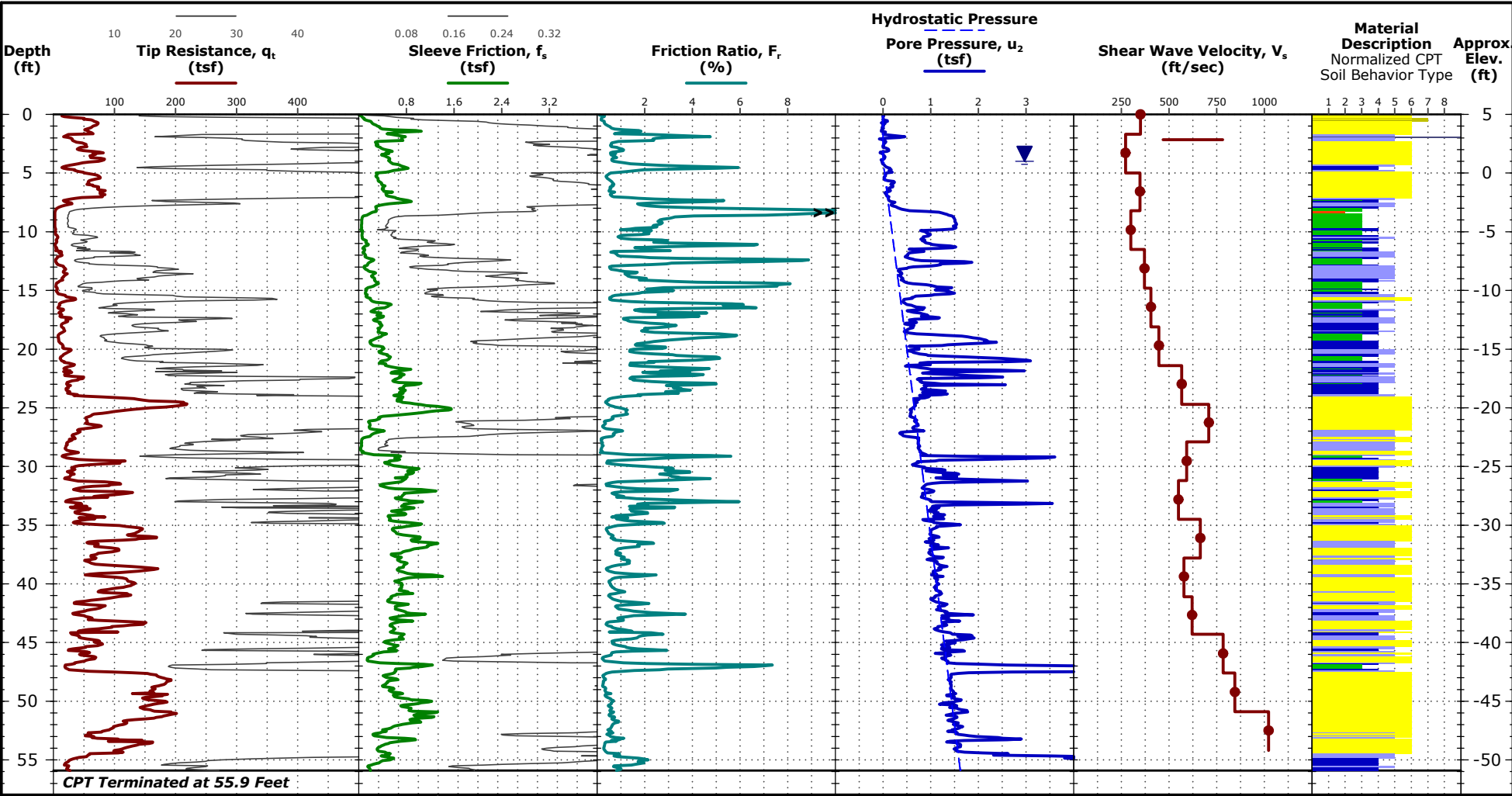
**Boring Completed**  
06-19-2023

# CPT Sounding ID B-03

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7281° Longitude: -76.6667°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 5-inches  
Cave-In Depth: 5 feet (wet)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation

▼ 4 ft measured water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

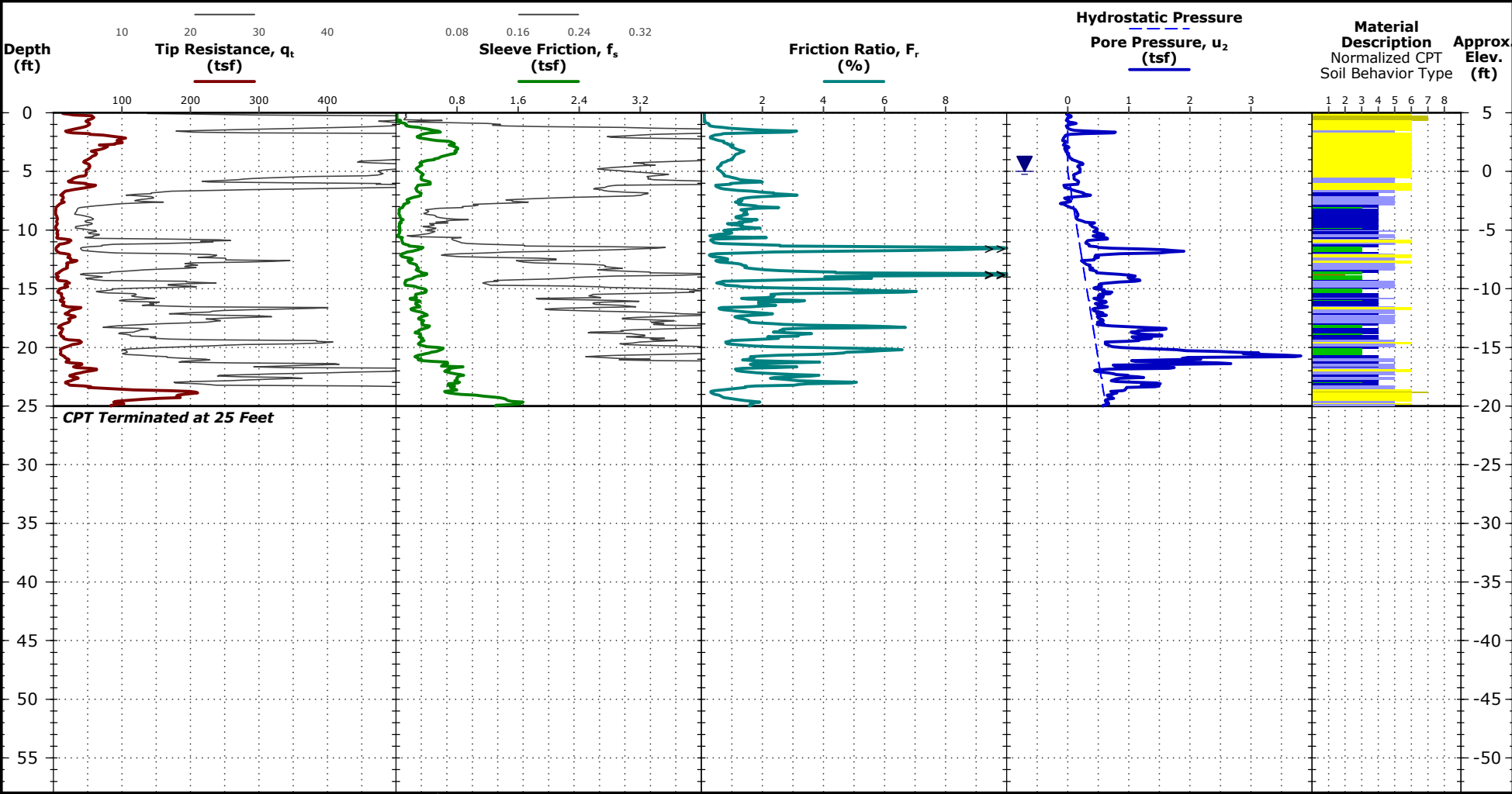
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID B-04

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7279° Longitude: -76.6668°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 3-inches  
Cave-In Depth: 5 feet (wet)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation

▼ 5 ft measured water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

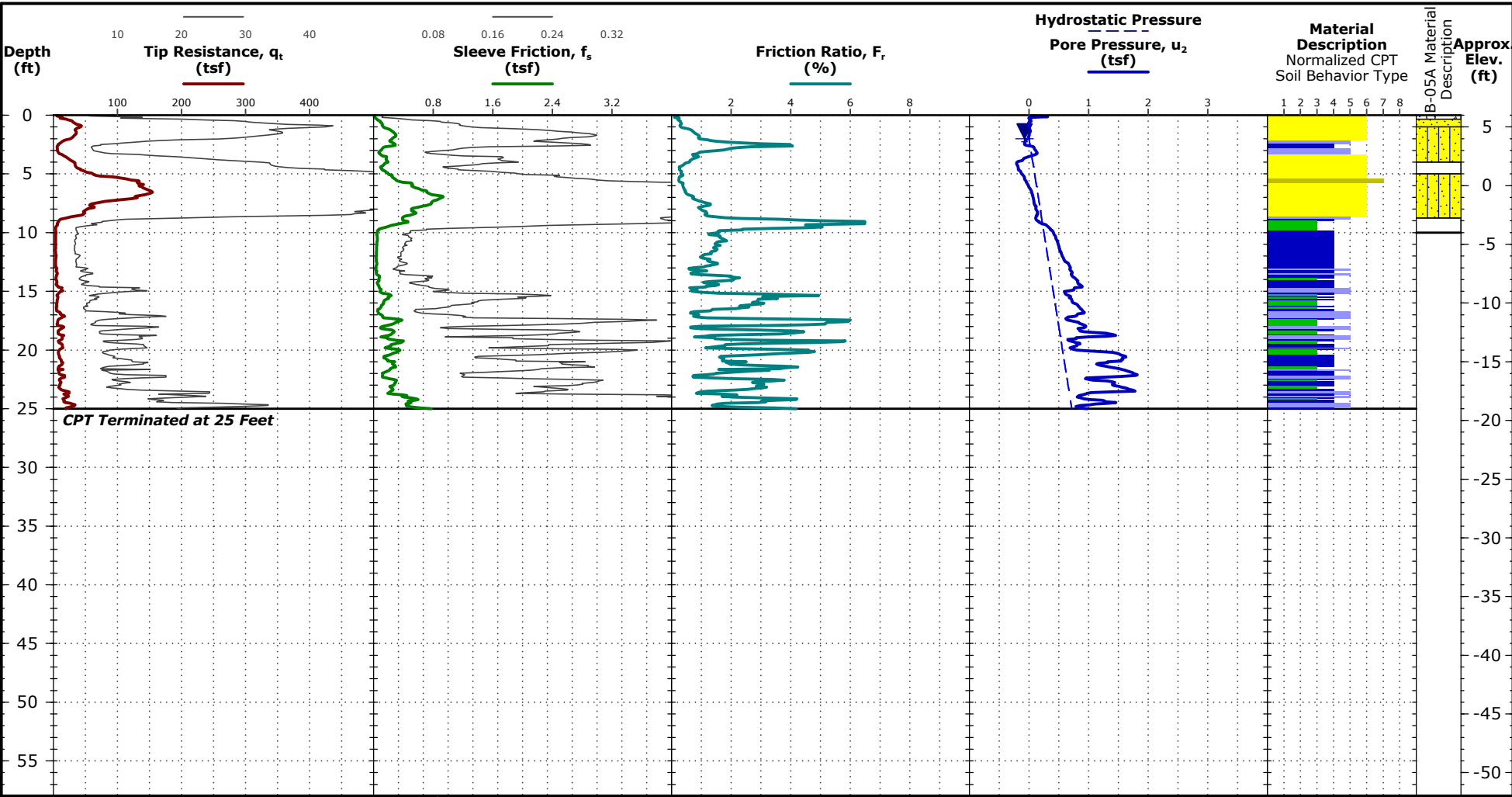
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID B-05

Elevation: 6 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7284° Longitude: -76.6661°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
See B-05A for the adjacent test's full details.  
Topsoil Thickness: 4-inches  
Cave-In Depth: 1 foot (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in






## Water Level Observation

▼ 2 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)


- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained


Boring Log No. B-05A

Model Layer	Graphic Log	Location: See <a href="#">Exploration Plan</a> Latitude: 34.7284° Longitude: -76.6661°		Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
								LL-PL-PI	
		Depth (Ft.)	Elevation: 6 (Ft.) +/-						
		<b>TOPSOIL</b> , 4-inches		0.3	5.67				
1		<b>POORLY GRADED SAND (SP)</b> , fine grained, tan		1.0	5				
		<b>SILTY SAND (SM)</b> , tan/gray							
									
							20.5	NP	27
				4.0	2				
		<b>NO RECOVERY</b>							
2				5.0	1				
		<b>SILTY SAND (SM)</b> , gray							
				8.8	-2.75				
		<b>NO RECOVERY</b>							
3									
				10.0	-4				
		<b>Boring Terminated at 10 Feet</b>			10				

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).  
See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

**Water Level Observations**  
 Estimated based on cave-in depth and moisture condition of soil samples

 Dry Cave-In

**Advancement Method**  
Direct Push

**Abandonment Method**

**Drill Rig**  
Geoprobe 7822

**Hammer Type**  
N/A

**Driller**  
T. Whitehead

**Logged by**  
M. Delaney

**Boring Started**  
06-19-2023

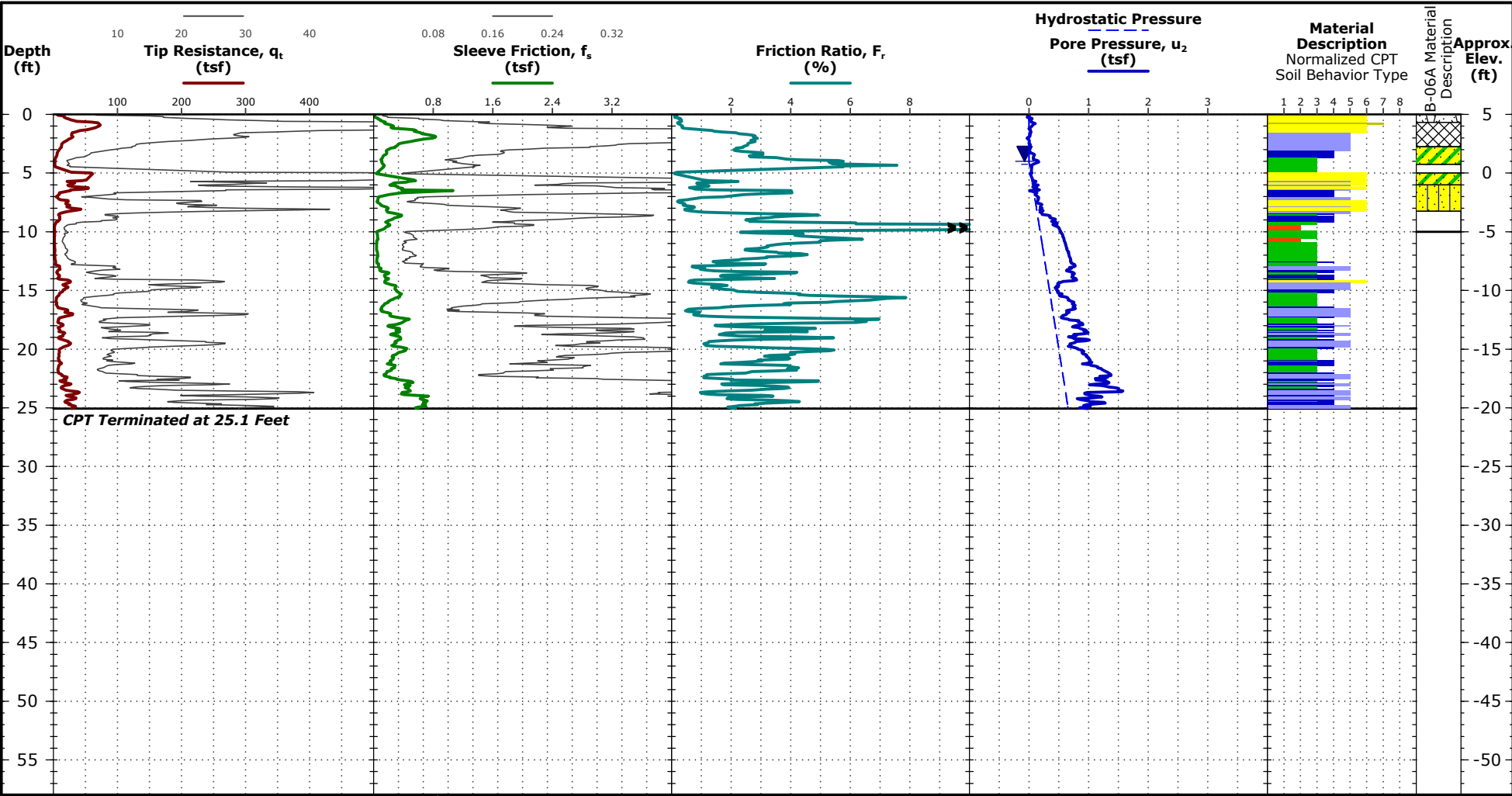
**Boring Completed**  
06-19-2023

# CPT Sounding ID B-06

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7282° Longitude: -76.6665°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

### Notes

Test Location: See [Exploration Plan](#)  
See B-06A for the adjacent test's full details.  
Topsoil Thickness: 8-inches  
Cave-In Depth: 5 feet (wet)

### CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in







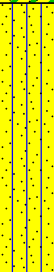
### Water Level Observation

4 ft measured water depth  
(used in normalizations and correlations)

### Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

## Boring Log No. B-06A

Model Layer	Graphic Log	Location: See <span>Exploration Plan</span>		Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
		Latitude: 34.7282° Longitude: -76.6665°						LL-PL-PI	
		Depth (Ft.)	Elevation: 5 (Ft.) +/-						
		<b>TOPSOIL</b> , 8-inches							
		0.7	4.33						
1		<b>FILL - SILTY SAND</b> , with gravel and wood debris, tan/brown/gray							
		2.8	2.25						
3		<b>CLAYEY SAND (SC)</b> , tan/gray							
		4.3	0.75						
		<b>NO RECOVERY</b>							
		5.0	0	5					
		<b>CLAYEY SAND (SC)</b> , tan/gray							
		6.0	-1						
2		<b>SILTY SAND (SM)</b> , gray							
		8.3	-3.25						
		<b>NO RECOVERY</b>							
3									
		10.0	-5	10					
		<b>Boring Terminated at 10 Feet</b>							

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).  
See [Supporting Information](#) for explanation of symbols and abbreviations.

### Notes

Elevation Reference: Approximate elevations obtained using Google Earth Pro

### Water Level Observations

At completion of drilling

Wet Cave-In

**Advancement Method**  
Direct Push

**Abandonment Method**

**Drill Rig**  
Geoprobe 7822

**Hammer Type**  
N/A

**Driller**  
T. Whitehead

**Logged by**  
M. Delaney

**Boring Started**  
06-19-2023

**Boring Completed**  
06-19-2023

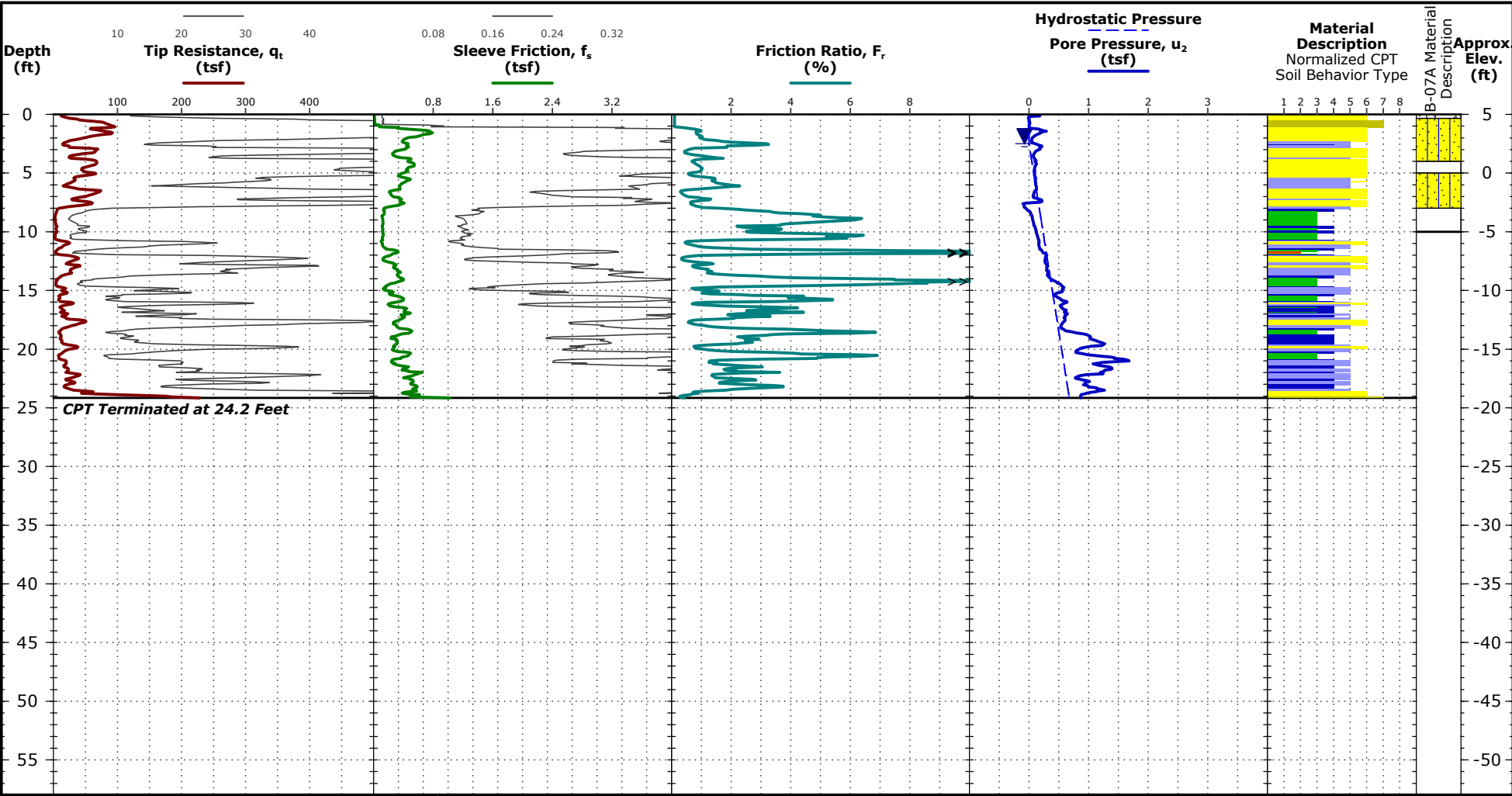


# CPT Sounding ID B-07

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7281° Longitude: -76.6669°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

### Notes

Test Location: See [Exploration Plan](#)  
See B-07A for the adjacent test's full details.  
Topsoil Thickness: 4-inches  
Cave-In Depth: 3 feet (dry)

### CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in






### Water Level Observation

▼ 2.5 ft estimated water depth  
(used in normalizations and correlations)

### Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

## Boring Log No. B-07A


Model Layer	Graphic Log	Location: See <span>Exploration Plan</span>		Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
		Latitude: 34.7281° Longitude: -76.6669°						LL-PL-PI	
		Depth (Ft.)	Elevation: 5 (Ft.) +/-						
		<b>TOPSOIL</b> , 4-inches		0.3	4.67				
2		<b>SILTY SAND (SM)</b> , brown to gray							
		Trace shell fragments to 2 feet							
									
							32.6	NP	13
				4.0	1				
		<b>NO RECOVERY</b>							
				5.0	0	5			
		<b>SILTY SAND (SM)</b> , gray							
				8.0	-3				
3		<b>NO RECOVERY</b>							
				10.0	-5	10			
		<b>Boring Terminated at 10 Feet</b>							


See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).  
See [Supporting Information](#) for explanation of symbols and abbreviations.

### Notes

Elevation Reference: Approximate elevations obtained using Google Earth Pro

### Water Level Observations

 Estimated based on cave-in depth and moisture condition of soil samples

 Dry Cave-In

**Advancement Method**  
Direct Push

**Abandonment Method**

**Drill Rig**  
Geoprobe 7822

**Hammer Type**  
N/A

**Driller**  
T. Whitehead

**Logged by**  
M. Delaney

**Boring Started**  
06-19-2023

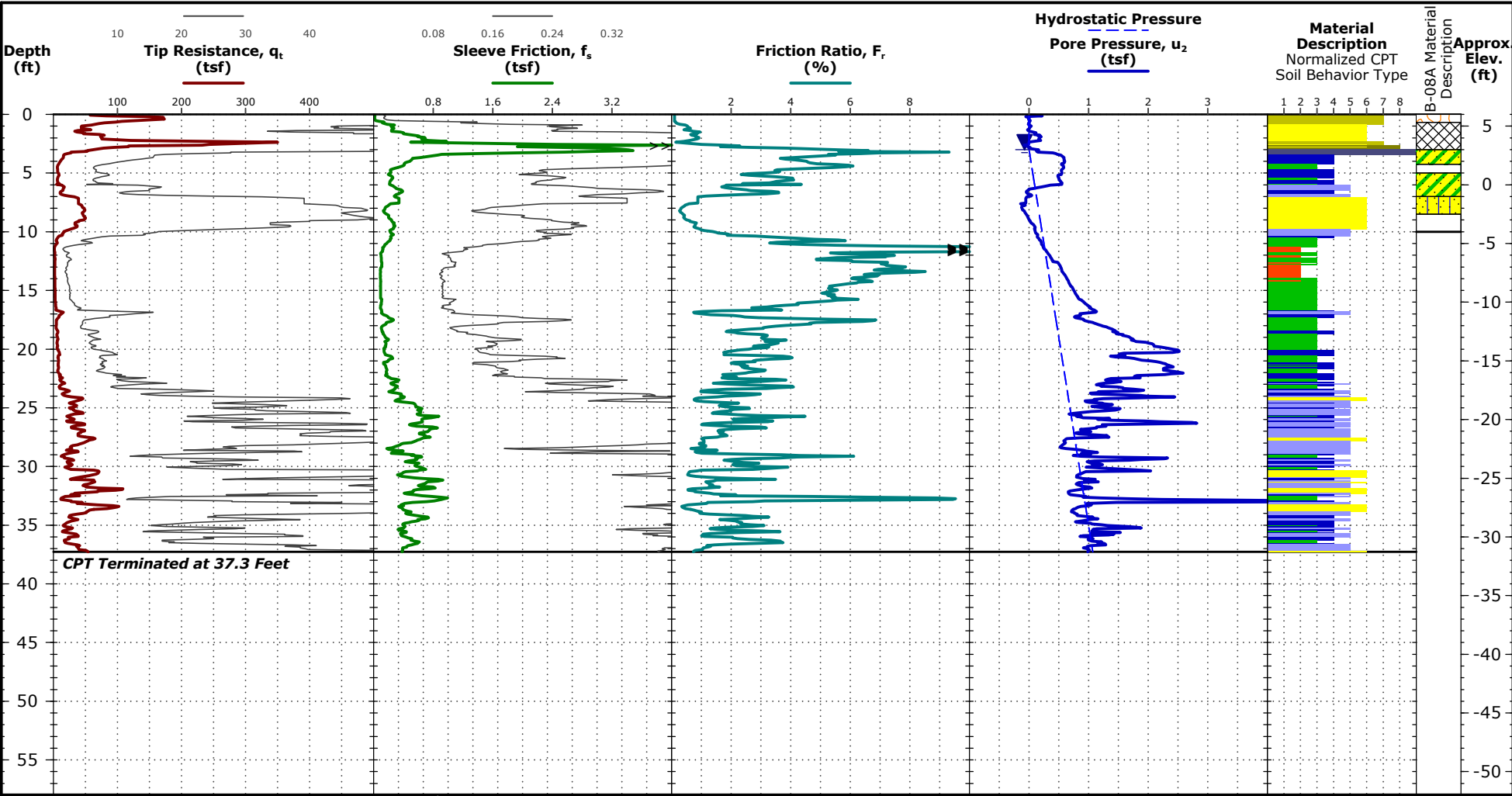
**Boring Completed**  
06-19-2023

# CPT Sounding ID B-08

Elevation: 6 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7292° Longitude: -76.6653°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
See B-08A for the adjacent test's full details.  
Gravel Thickness: 8-inches  
Cave-In Depth: 3 feet (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in





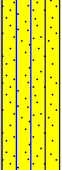
## Water Level Observation

▼ 3 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

## Boring Log No. B-08A


Model Layer	Graphic Log	Location: See <a href="#">Exploration Plan</a> Latitude: 34.7292° Longitude: -76.6653°		Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
		Depth (Ft.)	Elevation: 6 (Ft.) +/-					LL-PL-PI	
		<b>GRAVEL</b> , 8-inches		0.7	5.33				
1		<b>FILL - SILTY SAND</b> , with gravel and brick fragments, gray/brown/tan		3.0	3				
		<b>CLAYEY SAND (SC)</b> , tan/gray		4.3	1.75				
		<b>NO RECOVERY</b>		5.0	1				
3		<b>CLAYEY SAND (SC)</b> , tan to gray		7.0	-1		24.9	32-13-19	39
		<b>SILTY SAND (SM)</b> , gray		8.5	-2.5				
2		<b>NO RECOVERY</b>		10.0	-4				
		<b>Boring Terminated at 10 Feet</b>							


See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).  
See [Supporting Information](#) for explanation of symbols and abbreviations.

### Notes

Elevation Reference: Approximate elevations obtained using Google Earth Pro

### Water Level Observations

 Estimated based on cave-in depth and moisture condition of soil samples

 Dry Cave-In

**Advancement Method**  
Direct Push

**Abandonment Method**

**Drill Rig**  
Geoprobe 7822

**Hammer Type**  
N/A

**Driller**  
T. Whitehead

**Logged by**  
M. Delaney

**Boring Started**  
06-19-2023

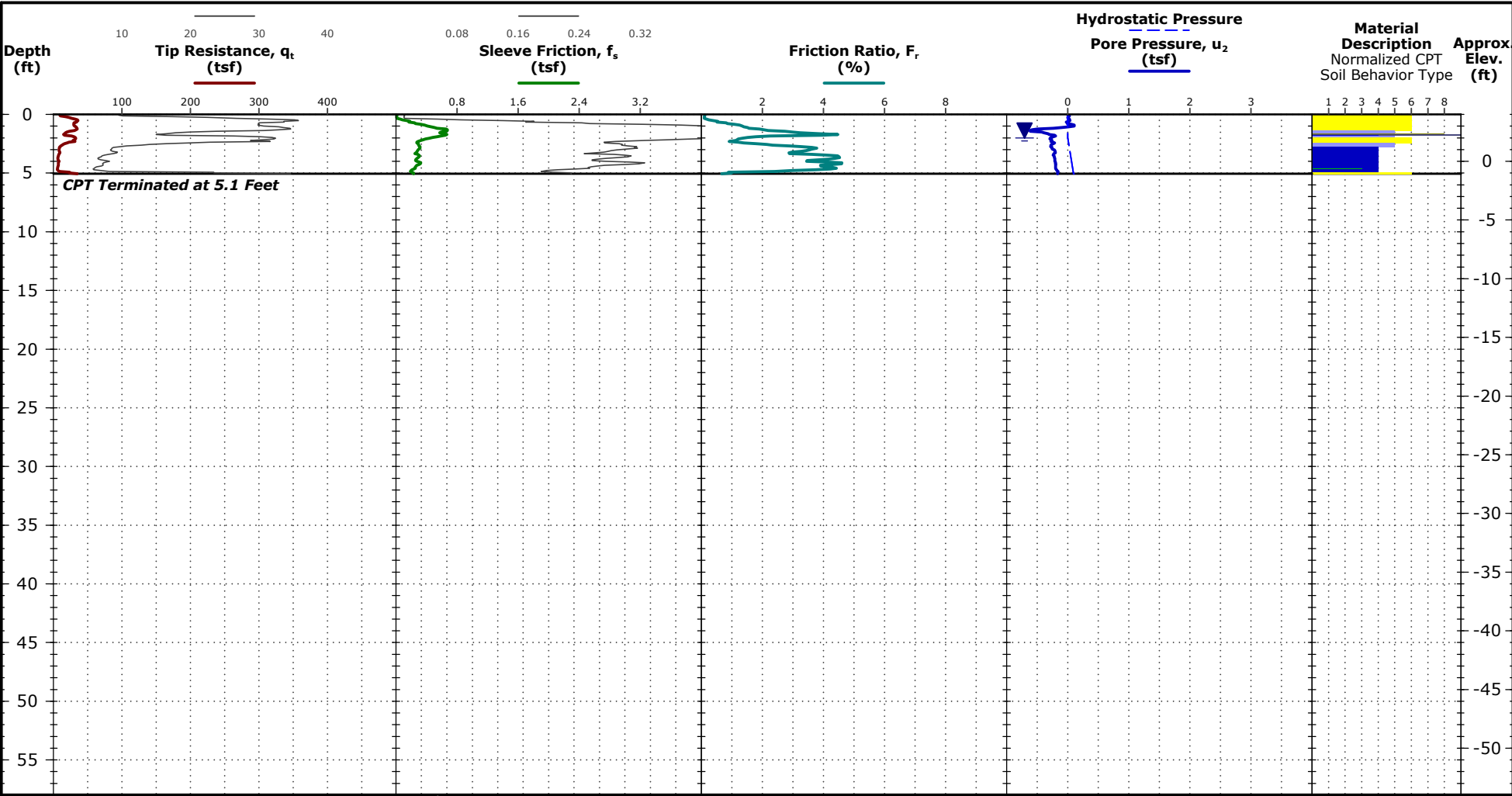
**Boring Completed**  
06-19-2023

# CPT Sounding ID P-01

Elevation: 4 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7281° Longitude: -76.6662°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 4-inches  
Cave-In Depth: 2 feet (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation

▼ 2 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

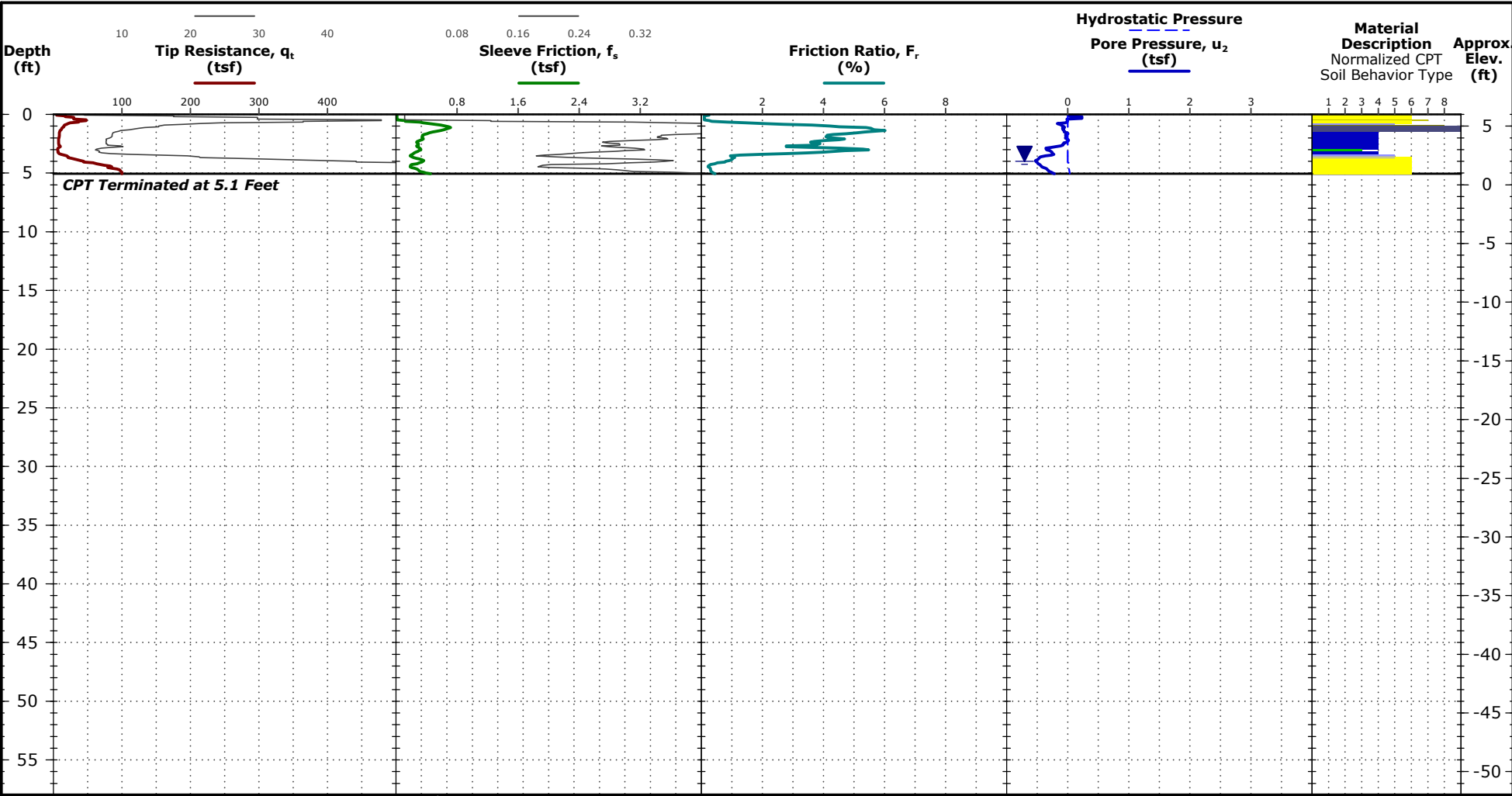
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID P-02

Elevation: 6 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7283° Longitude: -76.6657°

CPT Started: 6/19/2023  
CPT Completed: 6/19/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 4-inches, bulk sample 1'-3'  
Cave-In Depth: 4 feet (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation

▼ 4 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

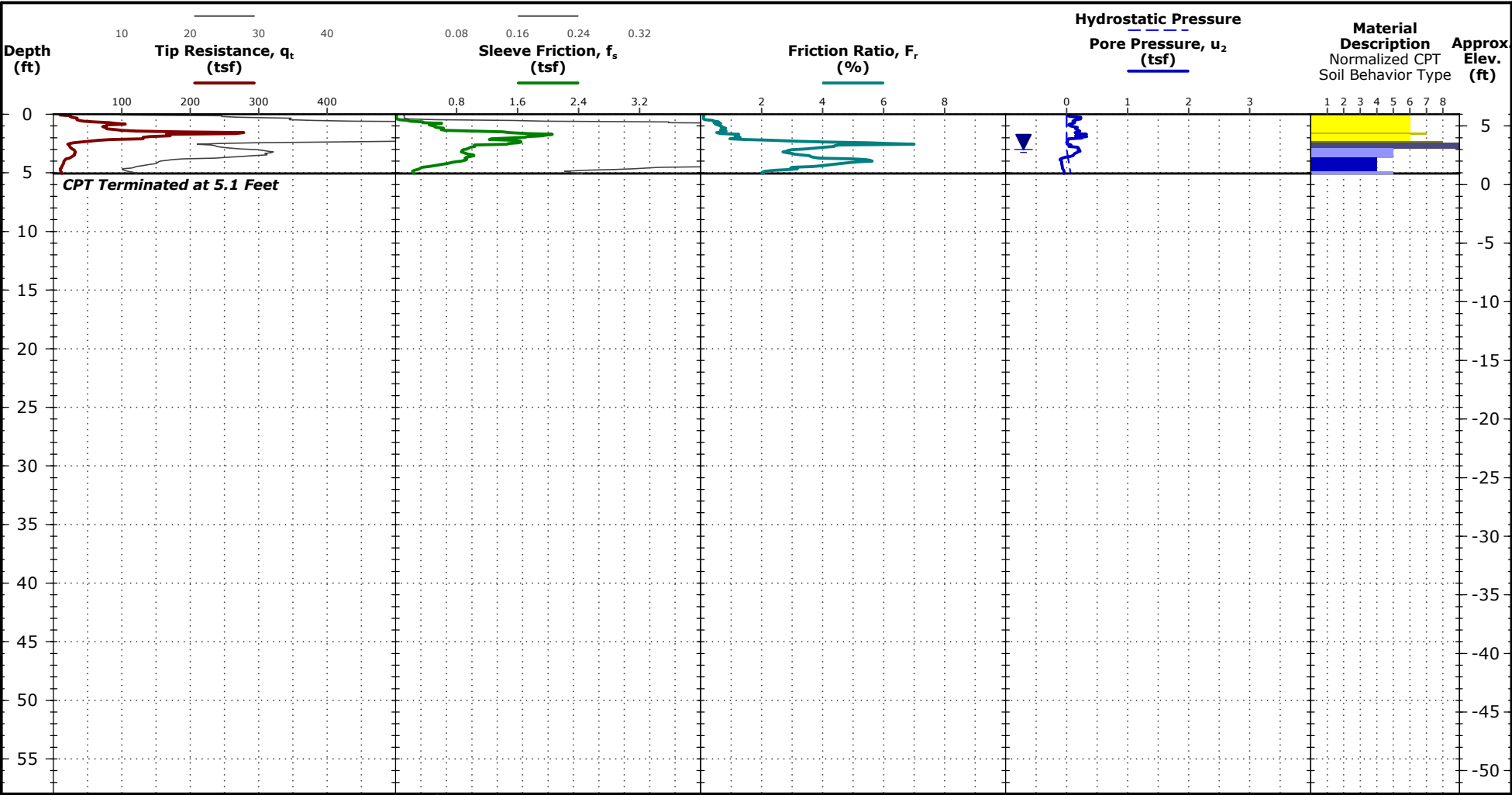
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID P-03

Elevation: 6 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7293° Longitude: -76.6656°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 4-inches  
Cave-In Depth: 3 feet (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation

▼ 3 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

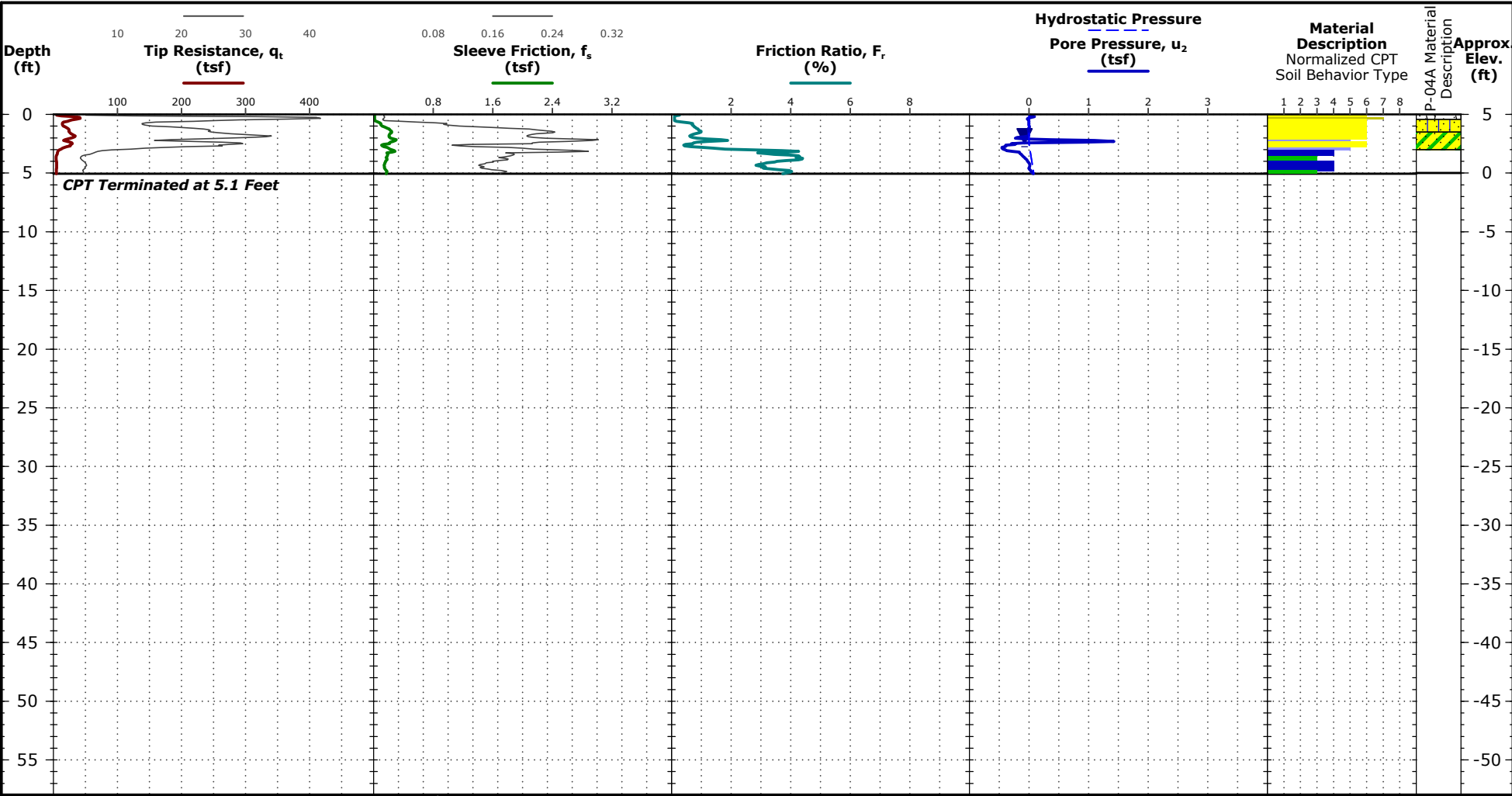
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID P-04

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7285° Longitude: -76.6651°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
See P-04A for the adjacent test's full details.  
Topsoil Thickness: 5-inches  
Cave-In Depth: 2 feet (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation


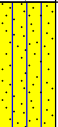



▼ 2.5 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained



Boring Log No. P-04A

Model Layer	Graphic Log	Location: See <a href="#">Exploration Plan</a> Latitude: 34.7285° Longitude: -76.6651°		Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
		Depth (Ft.)	Elevation: 5 (Ft.) +/-					LL-PL-PI	
		<b>TOPSOIL</b> , 5-inches		0.4	4.58				
2		<b>SILTY SAND (SM)</b> , brown/tan							
				1.5	3.5		15.6	NP	20
		<b>CLAYEY SAND (SC)</b> , tan to gray							
				3.0	2				
		<b>NO RECOVERY</b>							
3									
				5.0	0				
		<b>Boring Terminated at 5 Feet</b>			5				


See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).


See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**

Elevation Reference: Approximate elevations obtained using Google Earth Pro

**Water Level Observations**

 Estimated based on cave-in depth and moisture condition of soil samples

 Dry Cave-In

**Advancement Method**

Direct Push

**Abandonment Method**

**Drill Rig**

Geoprobe 7822

**Hammer Type**

N/A

**Driller**

T. Whitehead

**Logged by**

M. Delaney

**Boring Started**

06-20-2023

**Boring Completed**

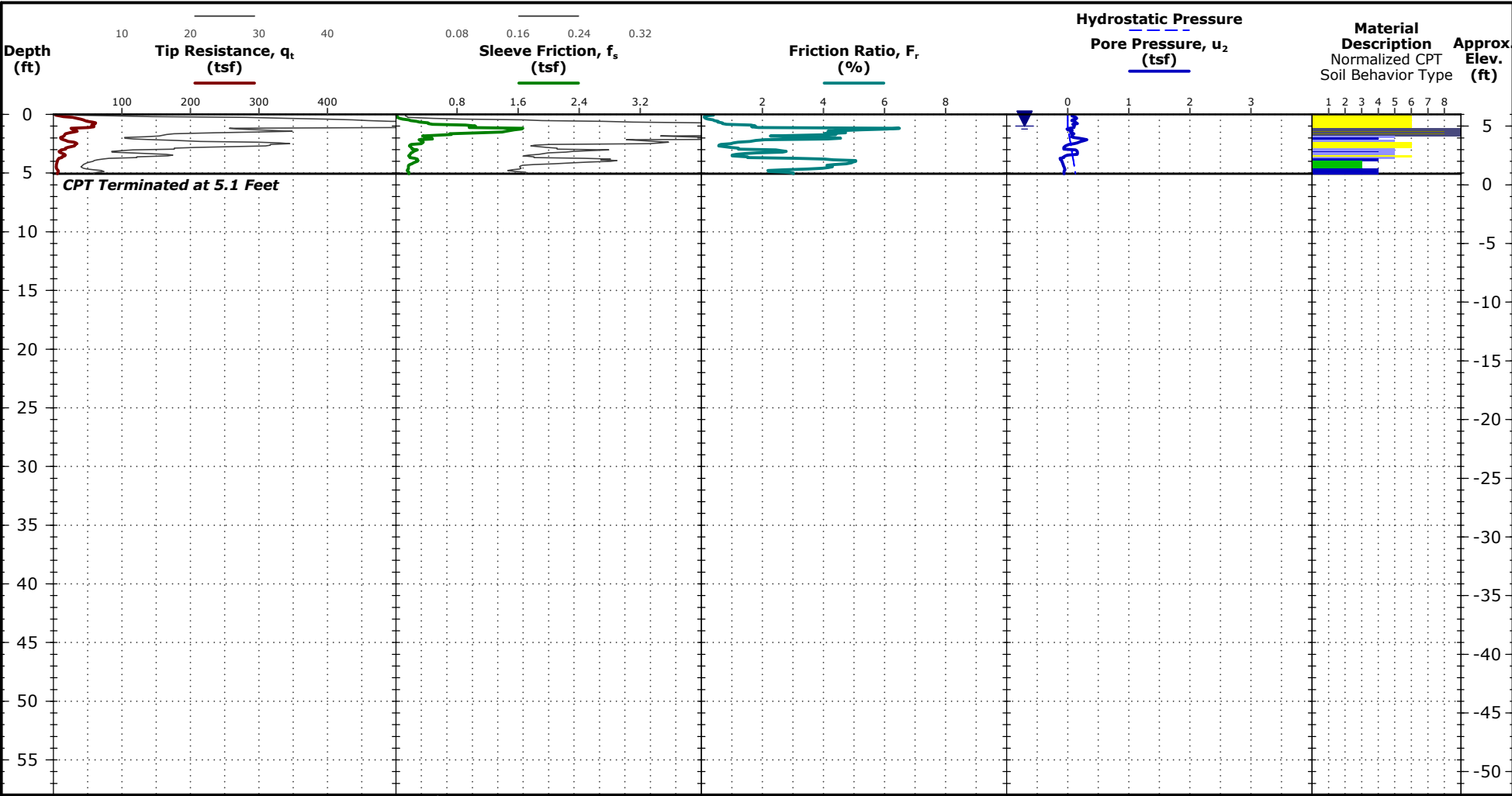
06-20-2023

# CPT Sounding ID P-05

Elevation: 6 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7289° Longitude: -76.6650°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 4-inches  
Cave-In Depth: 1 foot (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation

▼ 1 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

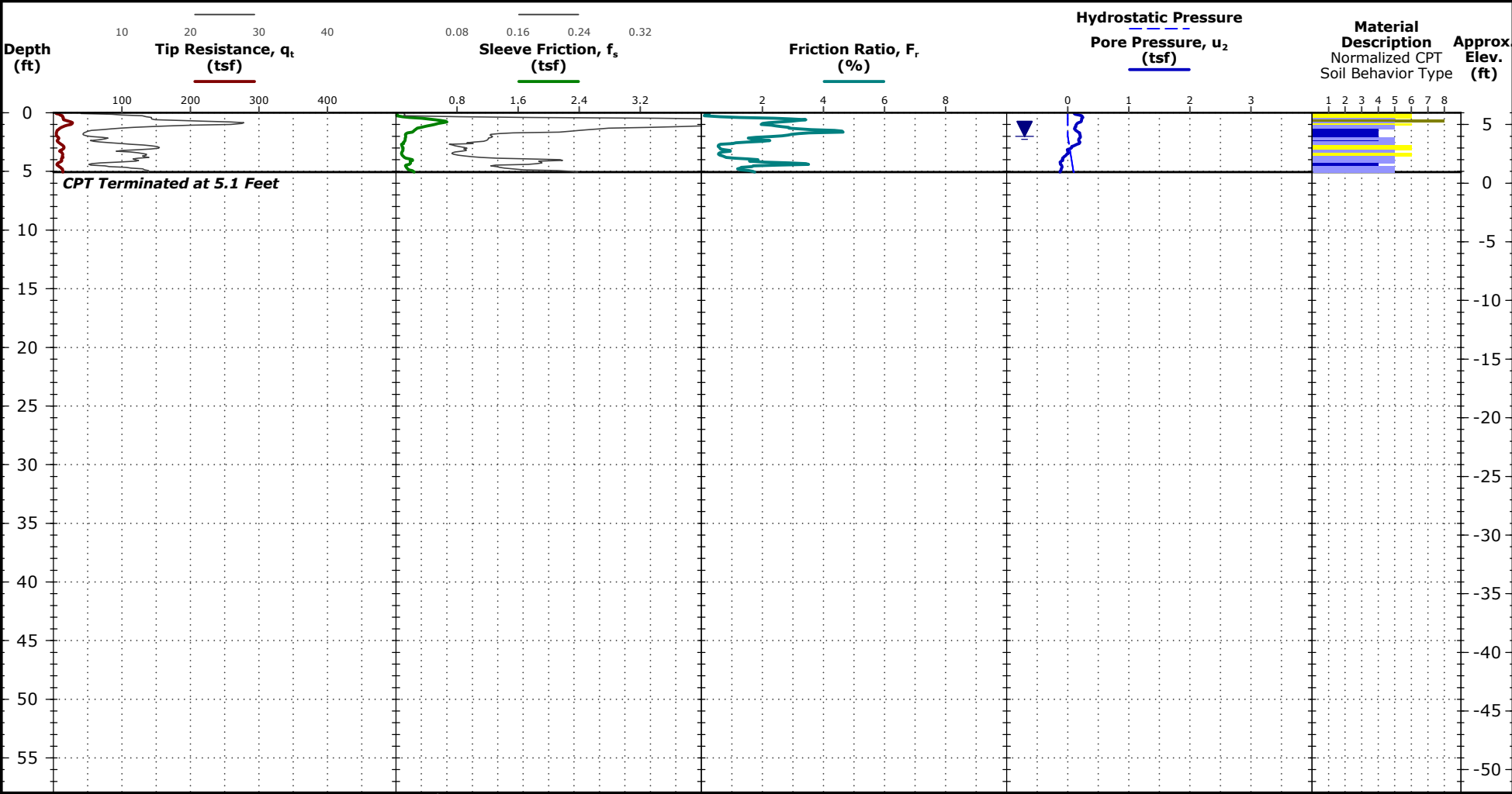
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID P-06

Elevation: 6 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7294° Longitude: -76.6650°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 2-inches  
Cave-In Depth: 2 feet (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in





## Water Level Observation



▼ 2 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

Boring Log No. P-07A

Model Layer	Graphic Log	Location: See <a href="#">Exploration Plan</a> Latitude: 34.7289° Longitude: -76.6668°		Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
								LL-PL-PI	
		Depth (Ft.)	Elevation: 5 (Ft.) +/-						
		0.2 <b>TOPSOIL</b> , 2-inches	4.83						
1		<b>FILL - SILTY SAND</b> , with rock fragments, gray to tan/brown							
		1.3	3.75						
		<b>CLAYEY SAND (SC)</b> , with organic material, black							
3		3.0	2						
		<b>NO RECOVERY</b>							
		5.0	0	5					
		<b>Boring Terminated at 5 Feet</b>							

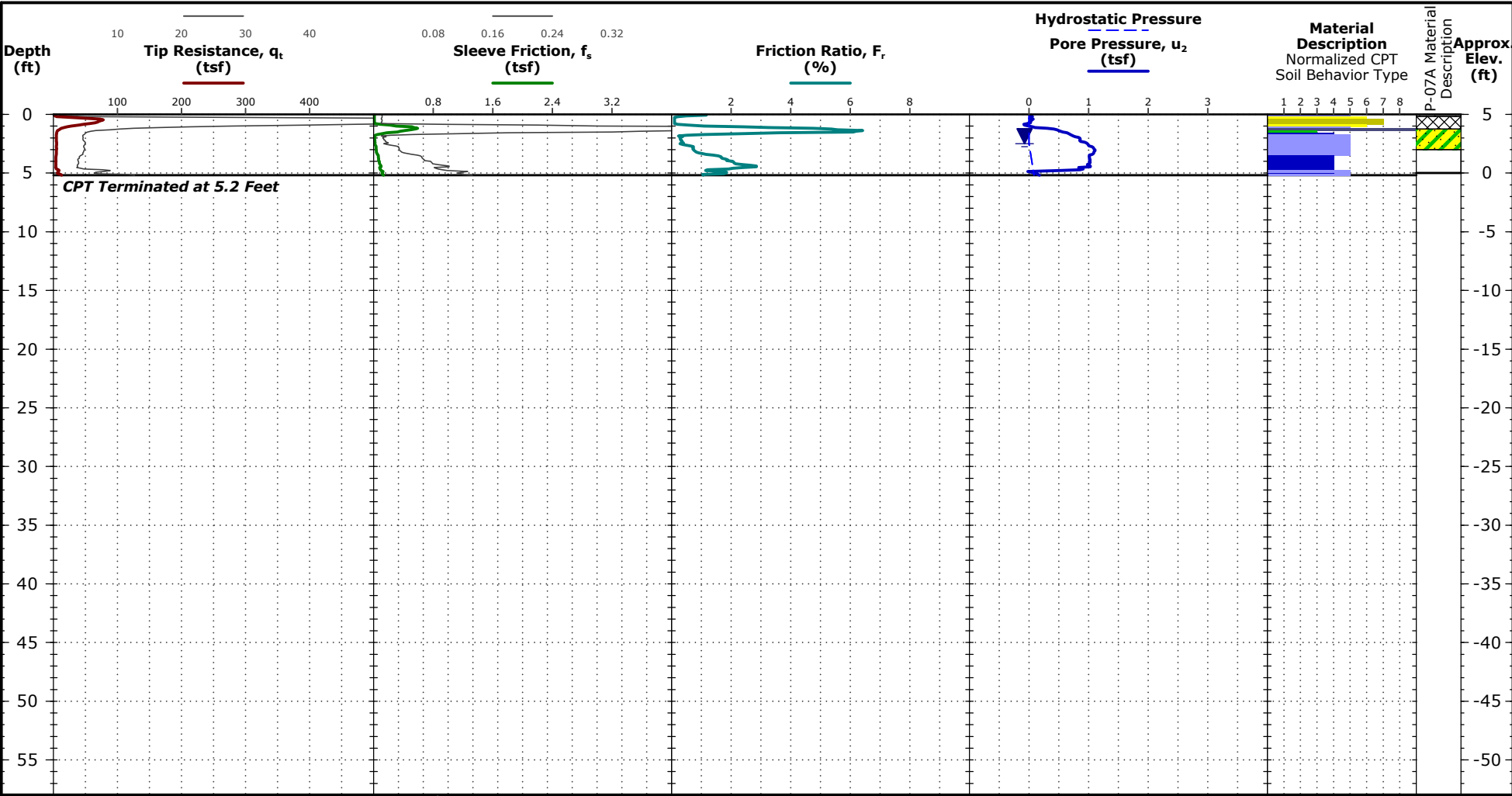
<b>Notes</b> See <a href="#">Exploration and Testing Procedures</a> for a description of field and laboratory procedures used and additional data (If any). See <a href="#">Supporting Information</a> for explanation of symbols and abbreviations.  Elevation Reference: Approximate elevations obtained using Google Earth Pro	<b>Water Level Observations</b>  Estimated based on cave-in depth and moisture condition of soil samples	<b>Drill Rig</b> Geoprobe 7822 <b>Hammer Type</b> N/A <b>Driller</b> T. Whitehead <b>Logged by</b> M. Delaney <b>Boring Started</b> 06-20-2023 <b>Boring Completed</b> 06-20-2023
	 Dry Cave-In <b>Advancement Method</b> Direct Push  <b>Abandonment Method</b>	

# CPT Sounding ID P-07

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7289° Longitude: -76.6668°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**  
Test Location: See [Exploration Plan](#)  
See P-07A for the adjacent test's full details.  
Topsoil Thickness: 2-inches  
Cave-In Depth: 2 feet (dry)

**CPT Equipment**  
CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

**Water Level Observation**  
▼ 2.5 ft estimated water depth  
(used in normalizations and correlations)

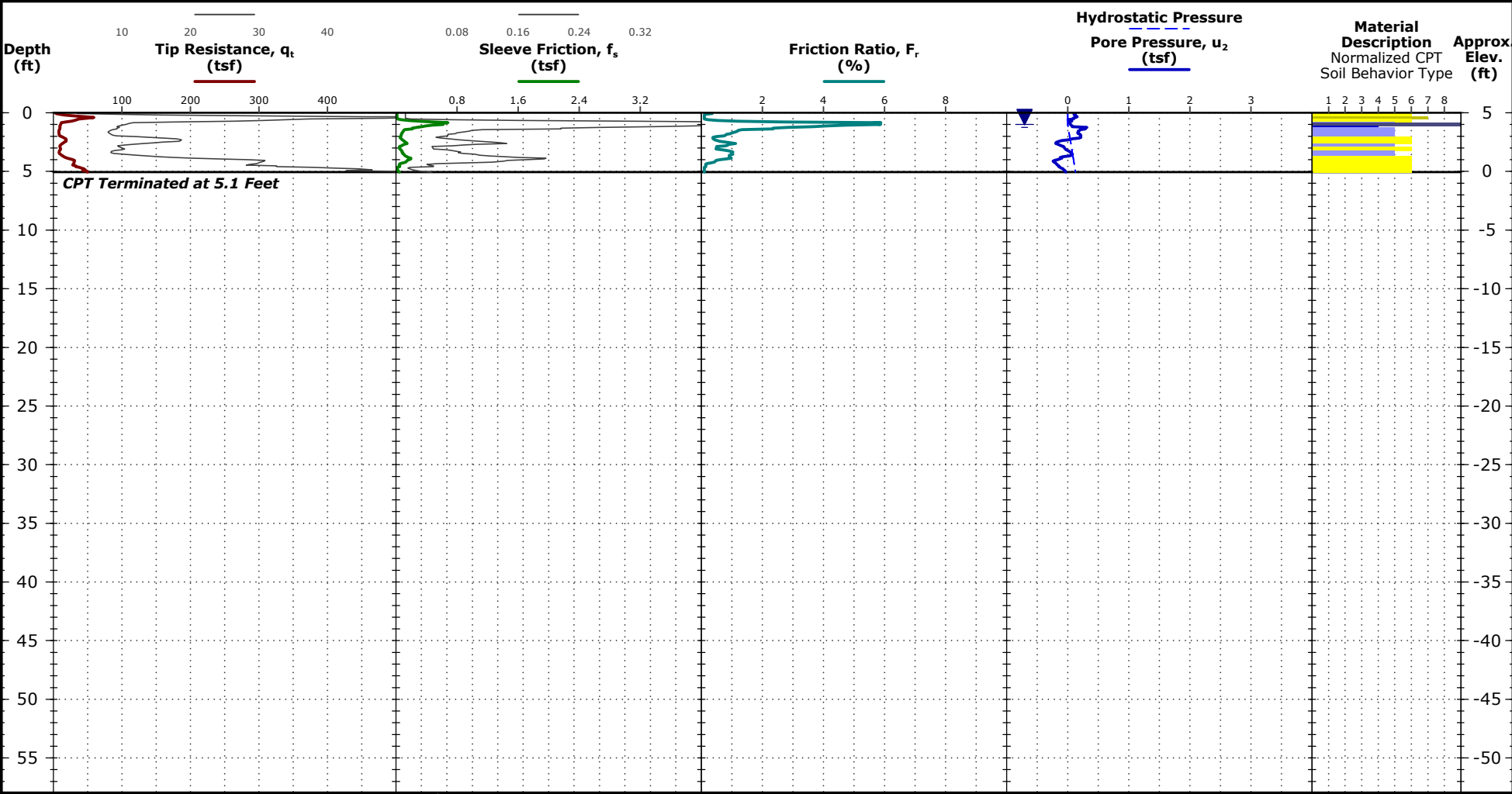
**Normalized Soil Behavior Type (Robertson 1990)**  
1 Sensitive, fine grained  
2 Organic soils - clay  
3 Clay - silty clay to clay  
4 Silt mixtures - clayey silt to silty clay  
5 Sand mixtures - silty sand to sandy silt  
6 Sands - clean sand to silty sand  
7 Gravelly sand to dense sand  
8 Very stiff sand to clayey sand  
9 Very stiff fine grained

# CPT Sounding ID P-08

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7292° Longitude: -76.6661°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

## Notes

Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 6-inches  
Cave-In Depth: 1 foot (dry)

## CPT Equipment

CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

## Water Level Observation

▼ 1 ft estimated water depth  
(used in normalizations and correlations)

## Normalized Soil Behavior Type (Robertson 1990)

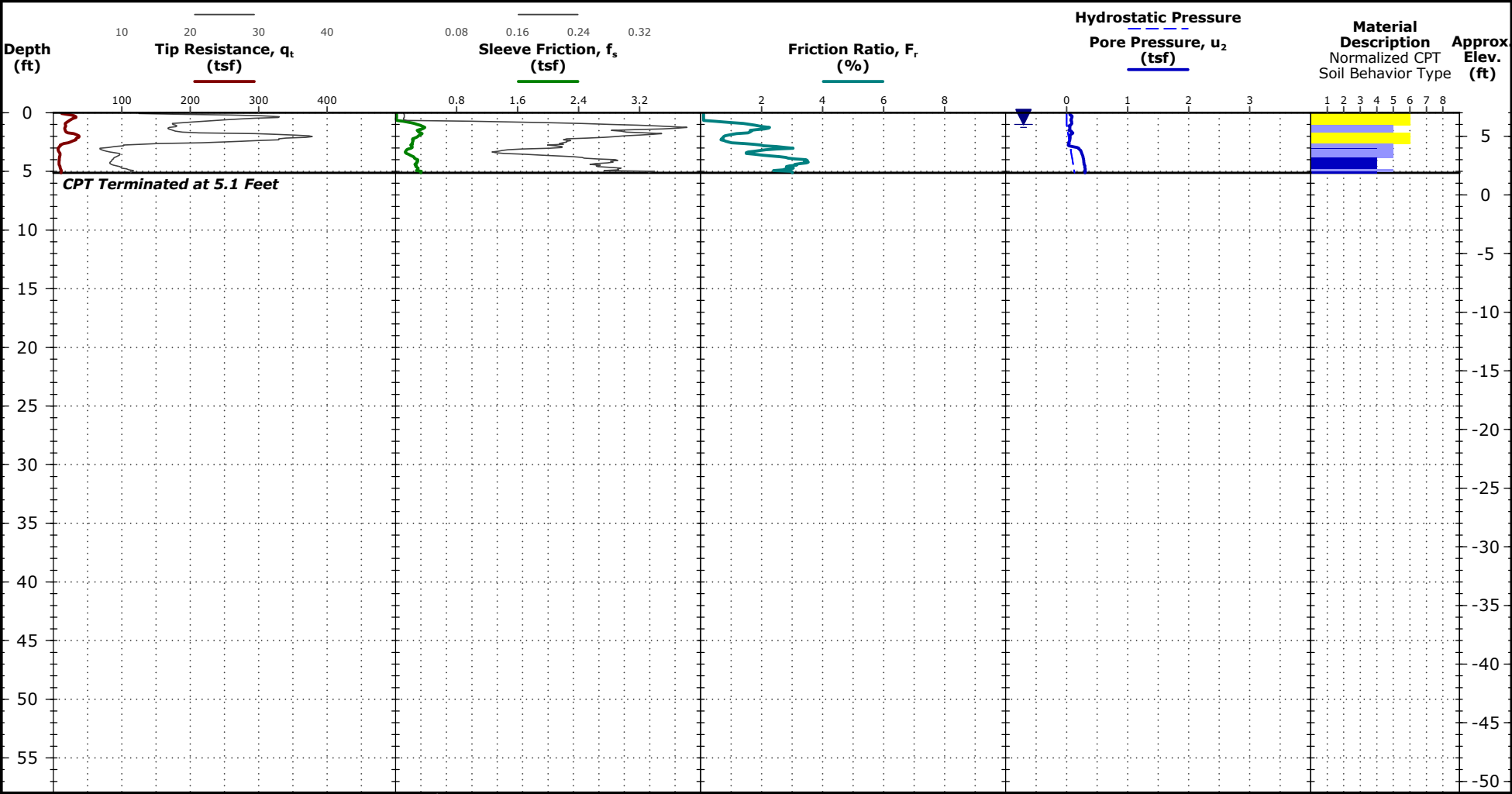
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID P-09

Elevation: 7 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7302° Longitude: -76.6659°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**  
Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 5-inches  
Cave-In Depth: 1 foot (dry)

**CPT Equipment**  
CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

**Water Level Observation**  
▼ 1 ft estimated water depth  
(used in normalizations and correlations)

**Normalized Soil Behavior Type (Robertson 1990)**

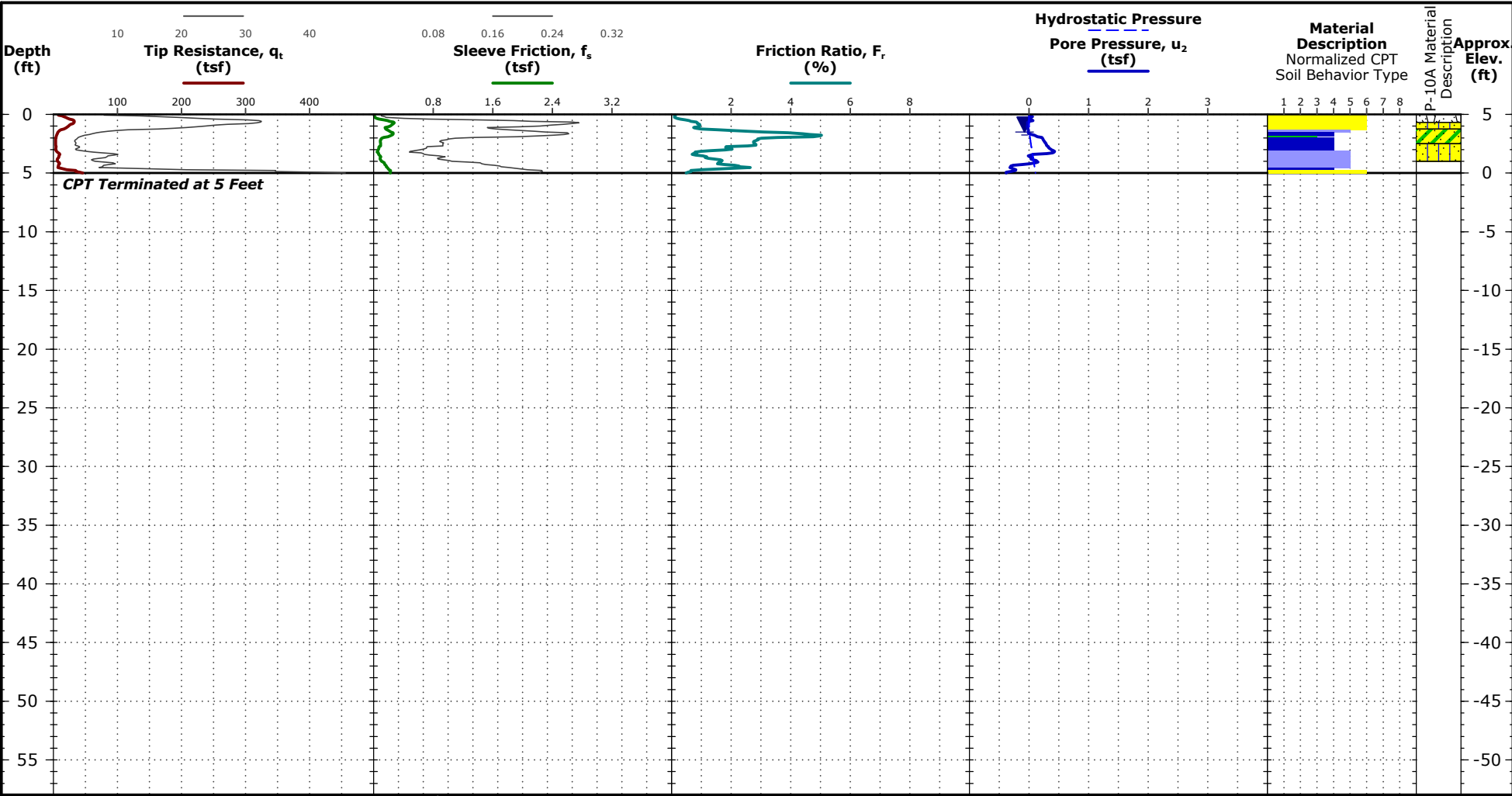
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID P-10

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7307° Longitude: -76.6663°

CPT Started: 6/20/2023  
CPT Completed: 6/20/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**  
Test Location: See [Exploration Plan](#)  
See P-10A for the adjacent test's full details.  
Topsoil Thickness: 8-inches  
Cave-In Depth: 3 feet (dry)

**CPT Equipment**  
CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in






**Water Level Observation**  
▼ 1.5 ft estimated water depth  
(used in normalizations and correlations)

**Normalized Soil Behavior Type (Robertson 1990)**

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained



## Boring Log No. P-10A

Model Layer	Graphic Log	Location: See <span>Exploration Plan</span>		Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
		Latitude: 34.7307° Longitude: -76.6663°						LL-PL-PI	
		Depth (Ft.)	Elevation: 5 (Ft.) +/-						
		<b>TOPSOIL</b> , 8-inches							
		0.7	4.33						
2		<b>SILTY SAND (SM)</b> , tan							
		1.3	3.75						
		<b>CLAYEY SAND (SC)</b> , tan/orange/gray			▽				
		2.5					22.2	26-18-8	34
3		<b>SILTY SAND (SM)</b> , gray to tan							
		2.5	2.5						
									
		4.0	1						
2		<b>NO RECOVERY</b>							
		5.0	0						
		<b>Boring Terminated at 5 Feet</b>		5					


See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).  
See [Supporting Information](#) for explanation of symbols and abbreviations.

### Notes

Elevation Reference: Approximate elevations obtained using Google Earth Pro

### Water Level Observations

▽ Estimated based on moisture condition of soil samples

 Dry Cave-In

**Advancement Method**  
Direct Push

**Abandonment Method**

**Drill Rig**  
Geoprobe 7822

**Hammer Type**  
N/A

**Driller**  
T. Whitehead

**Logged by**  
M. Delaney

**Boring Started**  
06-20-2023

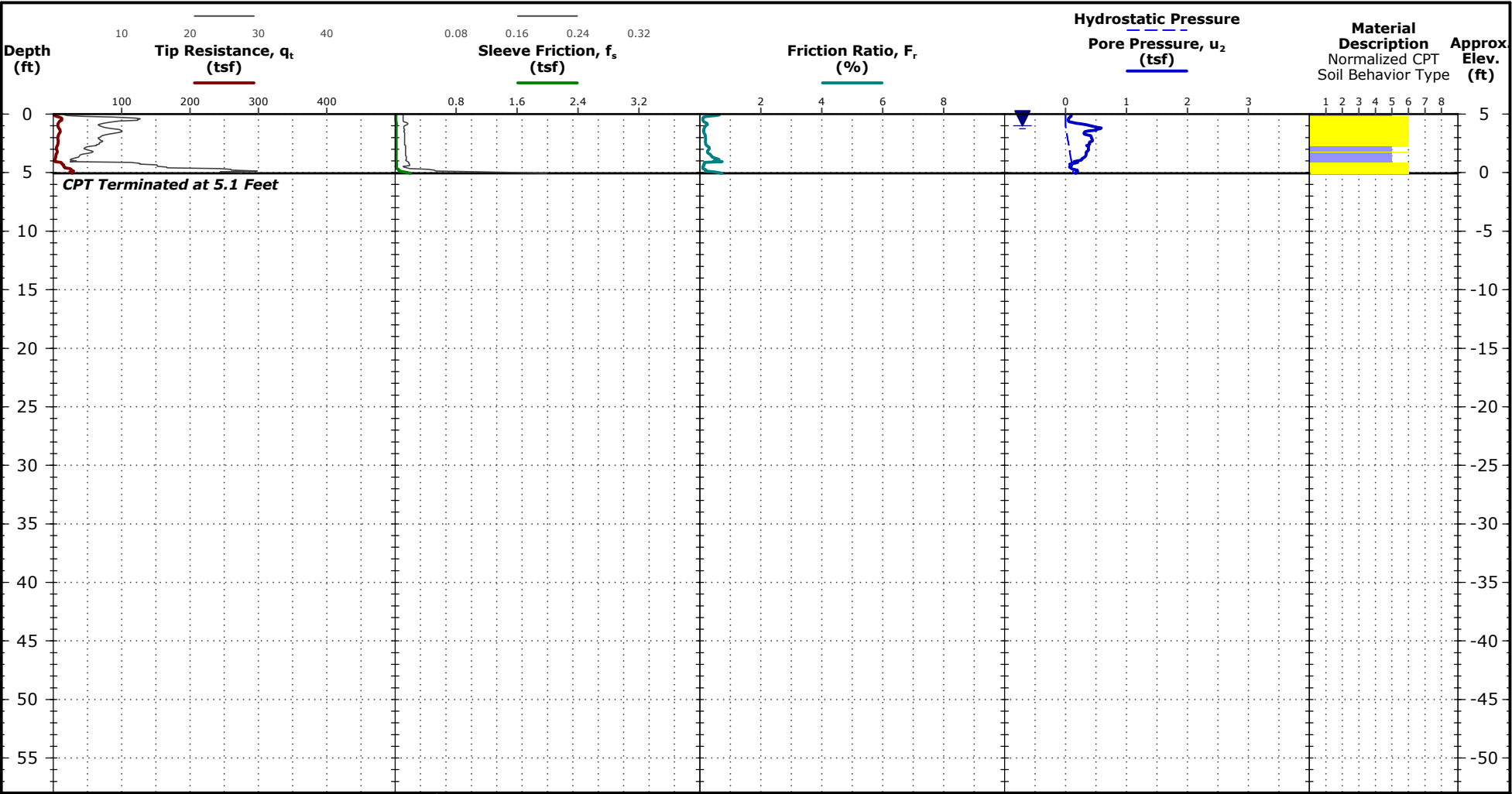
**Boring Completed**  
06-20-2023

# CPT Sounding ID P-11

Elevation: 5 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7307° Longitude: -76.6654°

CPT Started: 6/21/2023  
CPT Completed: 6/21/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**  
Test Location: See [Exploration Plan](#)  
Topsoil Thickness: 4-inches  
Cave-In Depth: 1 foot (dry)

**CPT Equipment**  
CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

**Water Level Observation**  
▼ 1 ft estimated water depth  
(used in normalizations and correlations)

**Normalized Soil Behavior Type (Robertson 1990)**

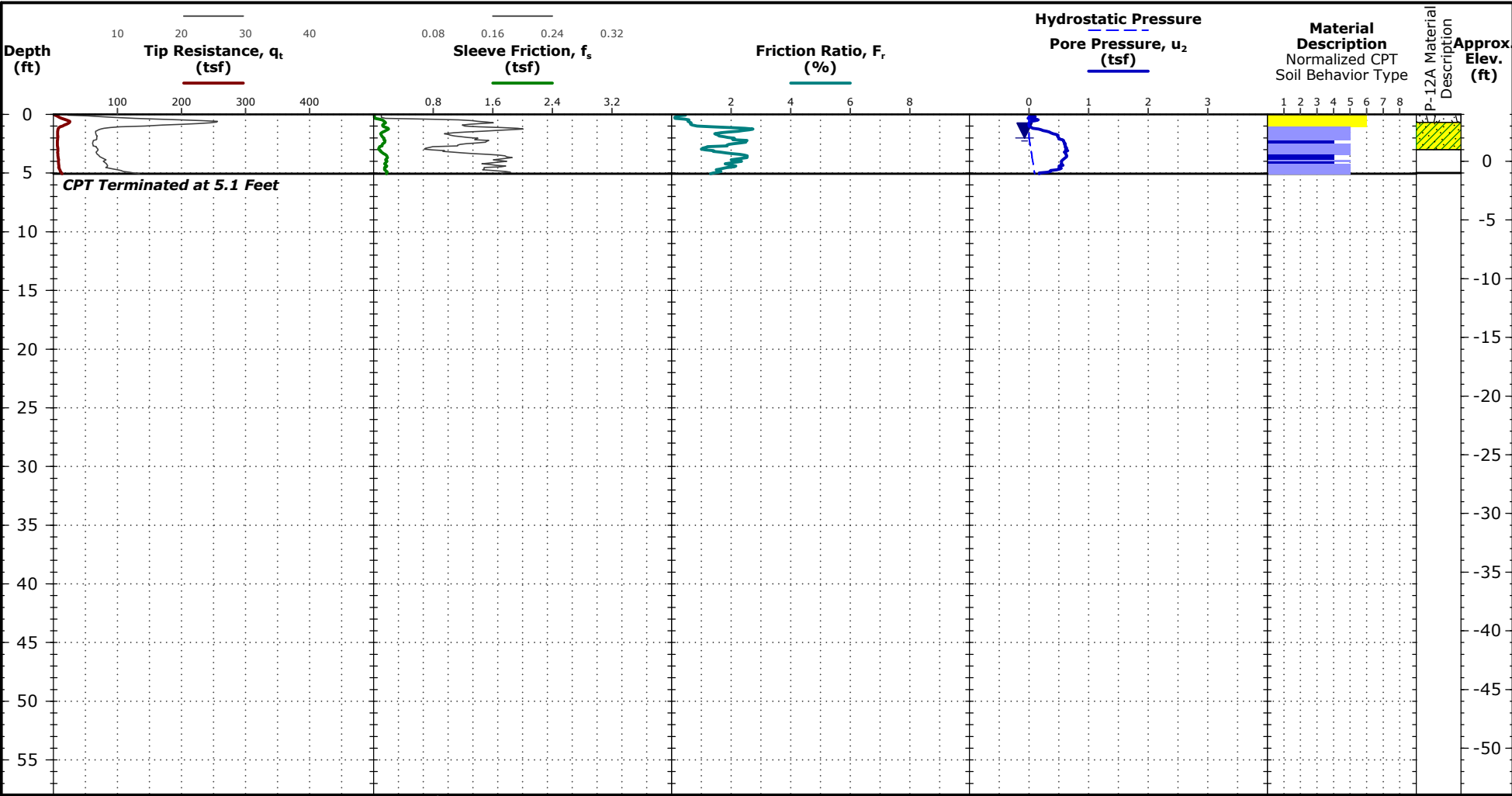
- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

# CPT Sounding ID P-12

Elevation: 4 (ft) +/-  
Elevation Reference: Approximate elevations obtained using Google Earth Pro

Latitude: 34.7302° Longitude: -76.6650°

CPT Started: 6/21/2023  
CPT Completed: 6/21/2023



See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data, if any.  
See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**  
Test Location: See [Exploration Plan](#)  
See P-12A for the adjacent test's full details.  
Topsoil Thickness: 8-inches  
Cave-In Depth: 2 feet (dry)





**CPT Equipment**  
CPT Rig: Geoprobe 7822  
Operator: T. Whitehead  
Auger anchors used as reaction force  
CPT sensor calibration reports available upon request  
Probe No. 5632 with net area ratio of 0.85  
 $U_2$  pore pressure transducer location  
Manufactured by Nova- Calibrated 2/17/2022  
Tip and sleeve areas of 15 cm<sup>2</sup> and 225 cm<sup>2</sup>  
Ring friction reducer with O.D. of 2 in

**Water Level Observation**  
▼ 2 ft estimated water depth  
(used in normalizations and correlations)

**Normalized Soil Behavior Type (Robertson 1990)**

- 1 Sensitive, fine grained
- 2 Organic soils - clay
- 3 Clay - silty clay to clay
- 4 Silt mixtures - clayey silt to silty clay
- 5 Sand mixtures - silty sand to sandy silt
- 6 Sands - clean sand to silty sand
- 7 Gravelly sand to dense sand
- 8 Very stiff sand to clayey sand
- 9 Very stiff fine grained

Boring Log No. P-12A

Model Layer	Graphic Log	Location: See Exploration Plan Latitude: 34.7302° Longitude: -76.6650°		Depth (Ft.)	Water Level Observations	Sample Type	Water Content (%)	Atterberg Limits	Percent Fines
								LL-PL-PI	
		Depth (Ft.)	Elevation: 4 (Ft.) +/-						
		<b>TOPSOIL</b> , 8-inches							
		0.7	3.33						
		<b>SANDY LEAN CLAY (CL)</b> , tan/orange/gray					26.5	40-14-26	53
									
3		3.0	1						
		<b>NO RECOVERY</b>							
		5.0	-1	5					
		<b>Boring Terminated at 5 Feet</b>							


See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).


See [Supporting Information](#) for explanation of symbols and abbreviations.

**Notes**

Elevation Reference: Approximate elevations obtained using Google Earth Pro

**Water Level Observations**

 Estimated based on moisture condition of soil samples

 Dry Cave-In

**Advancement Method**

Direct Push

**Abandonment Method**

**Drill Rig**

Geoprobe 7822

**Hammer Type**

N/A

**Driller**

T. Whitehead

**Logged by**

M. Delaney

**Boring Started**

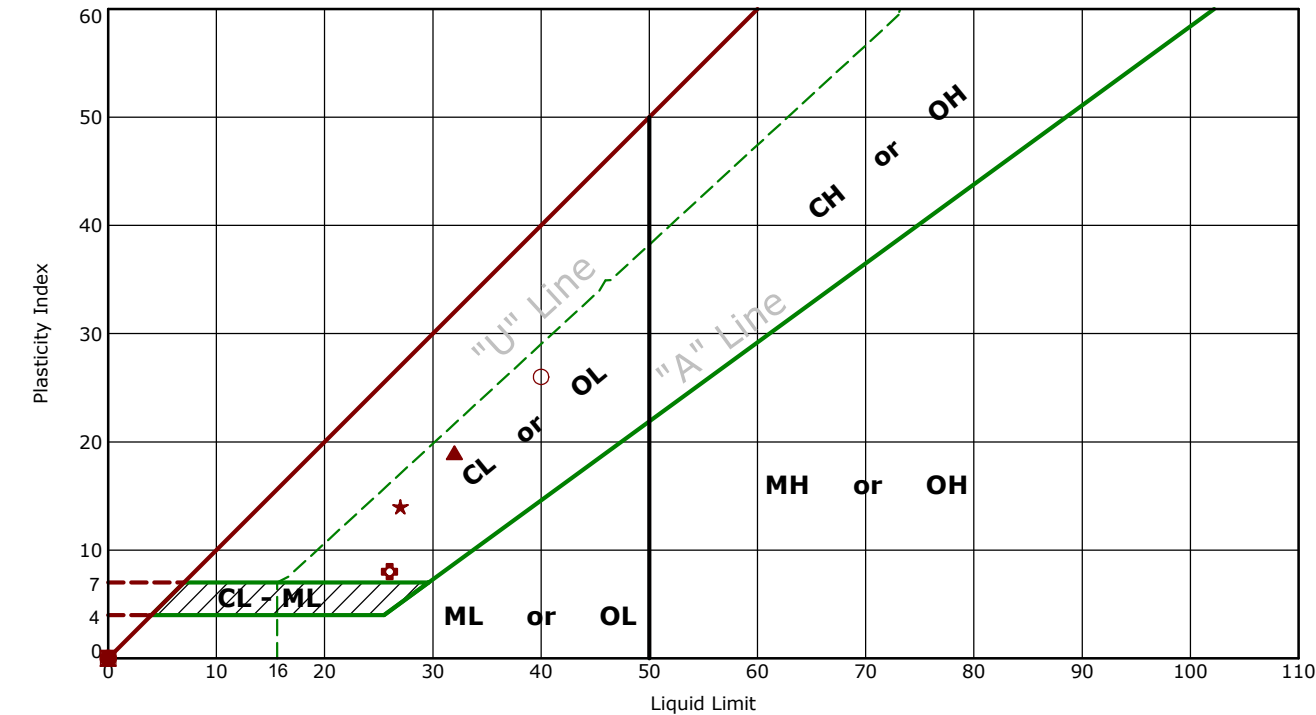
06-21-2023

**Boring Completed**

06-21-2023

# Atterberg Limit Results

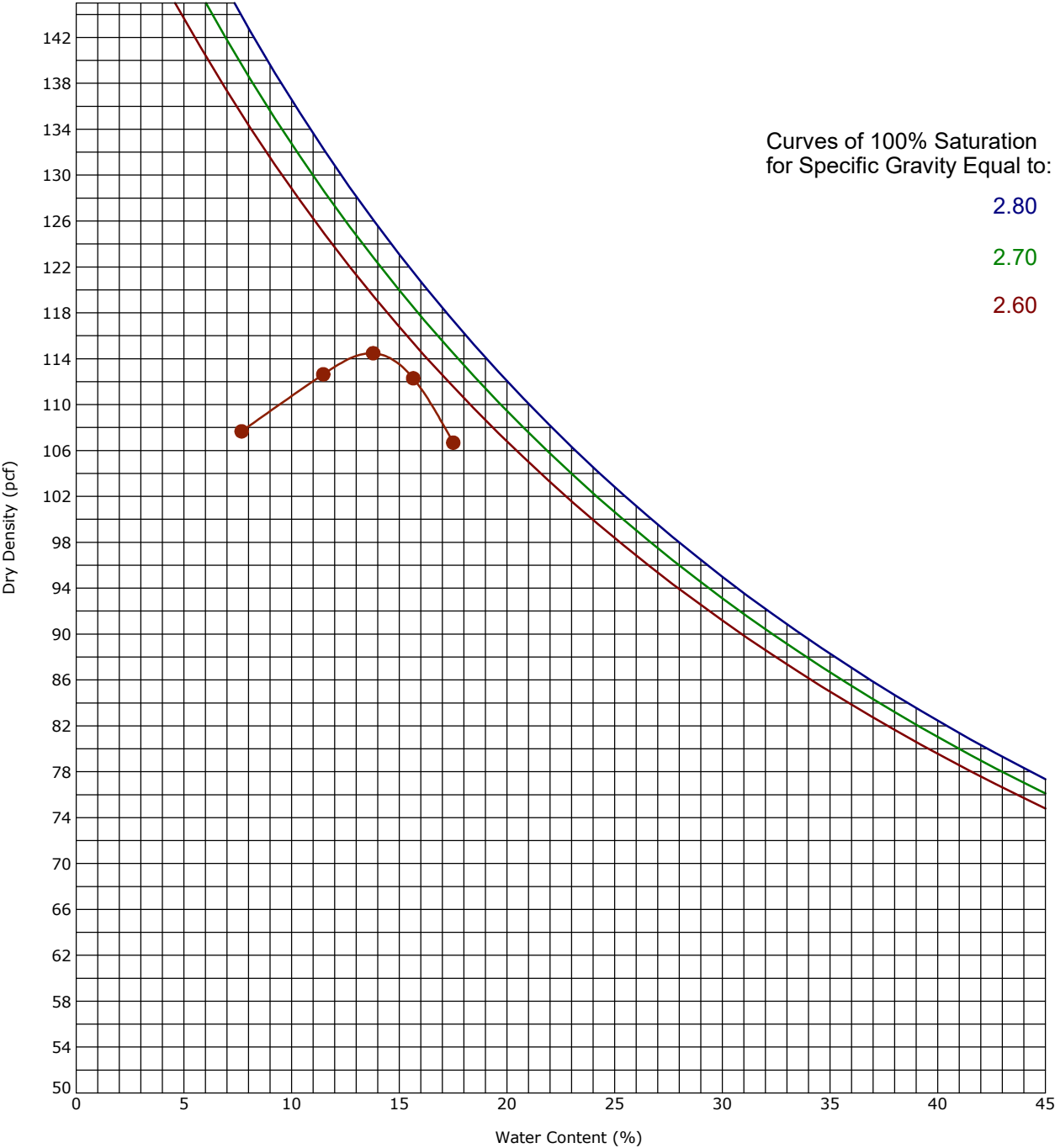
ASTM D4318



	Boring ID	Depth (Ft)	LL	PL	PI	Fines	USCS	Description
●	B-05A	2 - 3	NP	NP	NP	27.0	SM	SILTY SAND
⊠	B-07A	3 - 4	NP	NP	NP	13.1	SM	SILTY SAND
▲	B-08A	6.5 - 7	32	13	19	38.6	SC	CLAYEY SAND
★	P-02	1 - 3	27	13	14	34.8	SC	CLAYEY SAND
⊙	P-04A	1 - 1.5	NP	NP	NP	19.8	SM	SILTY SAND
⊕	P-10A	1.5 - 2	26	18	8	33.7	SC	CLAYEY SAND
○	P-12A	1 - 2	40	14	26	53.0	CL	SANDY LEAN CLAY


# Moisture-Density Relationship

## ASTM D698-Method A



Boring ID		Depth (Ft)		Description of Materials				
P-02		1 - 3		CLAYEY SAND(SC)				
Fines (%)	Fraction > mm size	LL	PL	PI	Test Method	Maximum Dry Density (pcf)	Optimum Water Content (%)	
35	0.0	27	13	14	ASTM D698-Method A	114.5	13.7	

# REPORT FOR CALIFORNIA BEARING RATIO

Report Number: K6235038.0001

Service Date: 07/06/23

Report Date: 07/11/23



2108 Capital Drive, Suite 103

Wilmington, NC 28405

910-478-9915

## Client

The Maritime Heritage Foundation of Beaufort, NC, Inc.

Mr. Leonard Y. Safrit, c/o Lisa Cox

PO Box 685

403 Ann Street

Beaufort, North Carolina 28516

## Project

NC Maritime Museum

2396 West Beaufort Road Extension

Beaufort, North Carolina

Project No. K6235038

## SAMPLE INFORMATION

Boring Number: P-02

Depth: 1.0 - 3.0'

Material Description: Brown Clayey Sand

Proctor Method: ASTM D698 - Method A

Maximum Dry Density (pcf): 114.5

Optimum Moisture: 13.7

Liquid Limit: 27

Plasticity Index: 13

## CBR TEST DATA

CBR Value at 0.100 inch

NA

CBR Value at 0.200 inch

12.9

Surcharge Weight (lbs)

10

Soaking Condition

Soaked

Length of Soaking (hours)

96

Swell (%)

0.0

## DENSITY DATA

Dry Density Before Soaking (pcf)

112.1

Compaction of Proctor (%)

97.9

## MOISTURE DATA

Before Compaction (%)

13.6

After Compaction (%)

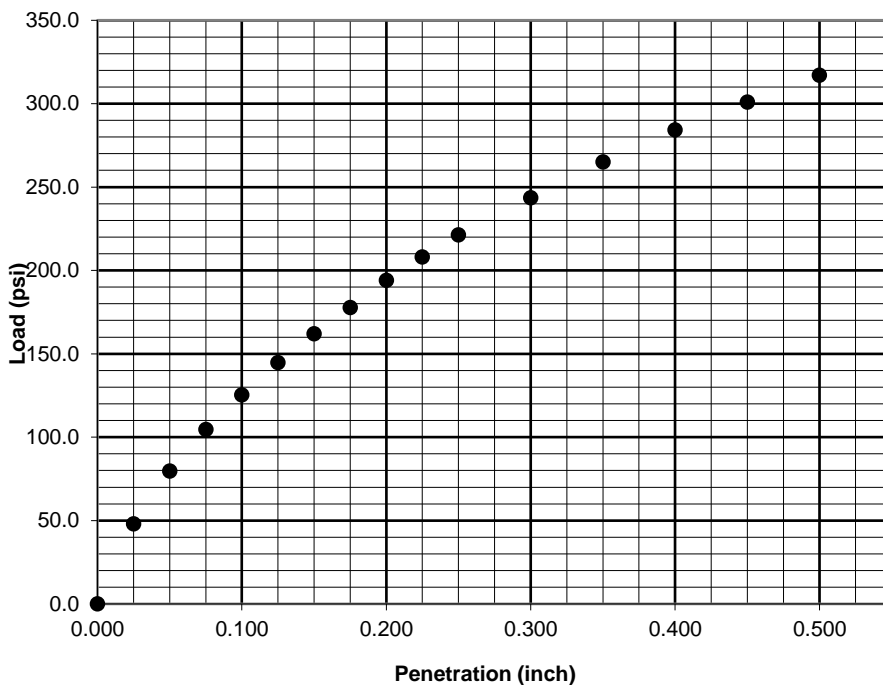
13.6

Top 1" After Soaking (%)

15.7

Average After Soaking (%)

15.7



## Comments:

Services: Obtain soil sample and test for California Bearing Ratio

Terracon Rep: Nicholas Lindley

Reported To: Justin DeNicola

Contractor:

Report Distribution

Test Methods: ASTM D1883

The tests were performed in general accordance with applicable ASTM, AASHTO, or DOT test methods. This report is exclusively for the use of the client indicated above and shall not be reproduced except in full without the written approval of Terracon. Test results transmitted herein are only applicable to the actual samples tested at the location(s) referenced and are not necessarily indicative of the properties of other apparently similar or identical materials.

## **Supporting Information**







### **Contents:**

General Notes  
CPT General Notes  
Unified Soil Classification System  
Settlement Monitoring Detail  
Stormwater Soils Evaluation Report

Note: All attachments are one page unless noted above.



## General Notes

Sampling	Water Level	Field Tests
 Grab Sample  GeoProbe Macro Core or Large Bore	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p>	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

### Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

### Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

### Strength Terms

Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Relative Density	Standard Penetration or N-Value (Blows/Ft.)	Consistency	Unconfined Compressive Strength Qu (tsf)	Standard Penetration or N-Value (Blows/Ft.)
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

### Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

# CPT GENERAL NOTES

## DESCRIPTION OF SYMBOLS AND ABBREVIATIONS



### DESCRIPTION OF GEOTECHNICAL CORRELATIONS

#### DESCRIPTION OF MEASUREMENTS AND CALIBRATIONS

To be reported per ASTM D5778:

Uncorrected Tip Resistance,  $q_c$   
Measured force acting on the cone divided by the cone's projected area

Corrected Tip Resistance,  $q_t$   
Cone resistance corrected for porewater and net area ratio effects  
 $q_t = q_c + u_2(1 - a)$

Where  $a$  is the net area ratio, a lab calibration of the cone typically between 0.70 and 0.85

Pore Pressure,  $u$   
Pore pressure measured during penetration  
 $u_1$  - sensor on the face of the cone  
 $u_2$  - sensor on the shoulder (more common)

Sleeve Friction,  $f_s$   
Frictional force acting on the sleeve divided by its surface area

Normalized Friction Ratio,  $F_r$   
The ratio as a percentage of  $f_s$  to  $q_t$ , accounting for overburden pressure

To be reported per ASTM D7400, if collected:

Shear Wave Velocity,  $V_s$   
Measured in a Seismic CPT and provides direct measure of soil stiffness

Normalized Tip Resistance,  $Q_{tn}$   
 $Q_{tn} = ((q_t - \sigma_{v0})/P_a)(P_a/\sigma'_{v0})^{0.5}$   
 $n = 0.381(I_c) + 0.05(\sigma'_{v0}/P_a) - 0.15$

Over Consolidation Ratio, OCR  
OCR (1) =  $0.25(Q_{tn})^{0.25}$   
OCR (2) =  $0.33(Q_{tn})$

Undrained Shear Strength,  $S_u$   
 $S_u = Q_{tn} \times \sigma'_{v0}/N_{kt}$   
 $N_{kt}$  is a soil-specific factor (shown on  $S_u$  plot)

Sensitivity,  $S_t$   
 $S_t = (q_t - \sigma'_{v0}/N_{kt}) \times (1/f_s)$

Effective Friction Angle,  $\phi'$   
 $\phi' (1) = \tan^{-1}(0.373[\log(q_t/\sigma'_{v0}) + 0.29])$   
 $\phi' (2) = 17.6 + 11[\log(Q_{tn})]$

Unit Weight,  $\gamma$   
 $\gamma = (0.27[\log(F_r)] + 0.36[\log(q_t/\text{atm})] + 1.236) \times \gamma_{water}$   
 $\sigma_{v0}$  is taken as the incremental sum of the unit weights

Small Strain Shear Modulus,  $G_0$   
 $G_0 (1) = \rho V_s^2$   
 $G_0 (2) = 0.015 \times 10^{(0.55I_c + 1.68)}(q_t - \sigma_{v0})$

Soil Behavior Type Index,  $I_c$   
 $I_c = [(3.47 - \log(Q_{tn}))^2 + (\log(F_r) + 1.22)^2]^{0.5}$

SPT  $N_{60}$   
 $N_{60} = (q_t/\text{atm}) / 10^{(1.1268 - 0.2817I_c)}$

Elastic Modulus,  $E_s$  (assumes  $q_t/\text{atm} \sim 0.3$ , i.e. FS = 3)

$E_s (1) = 2.6\psi G_0$  where  $\psi = 0.56 - 0.33\log Q_{tn, \text{clean sand}}$

$E_s (2) = G_0$

$E_s (3) = 0.015 \times 10^{(0.55I_c + 1.68)}(q_t - \sigma_{v0})$

$E_s (4) = 2.5q_t$

Constrained Modulus,  $M$

$M = \alpha_M(q_t - \sigma_{v0})$

For  $I_c > 2.2$  (fine-grained soils)

$\alpha_M = Q_{tn}$  with maximum of 14

For  $I_c < 2.2$  (coarse-grained soils)

$\alpha_M = 0.0188 \times 10^{(0.55I_c + 1.68)}$

Hydraulic Conductivity,  $k$

For  $1.0 < I_c < 3.27$   $k = 10^{(0.952 - 3.04I_c)}$

For  $3.27 < I_c < 4.0$   $k = 10^{(-4.52 - 1.37I_c)}$

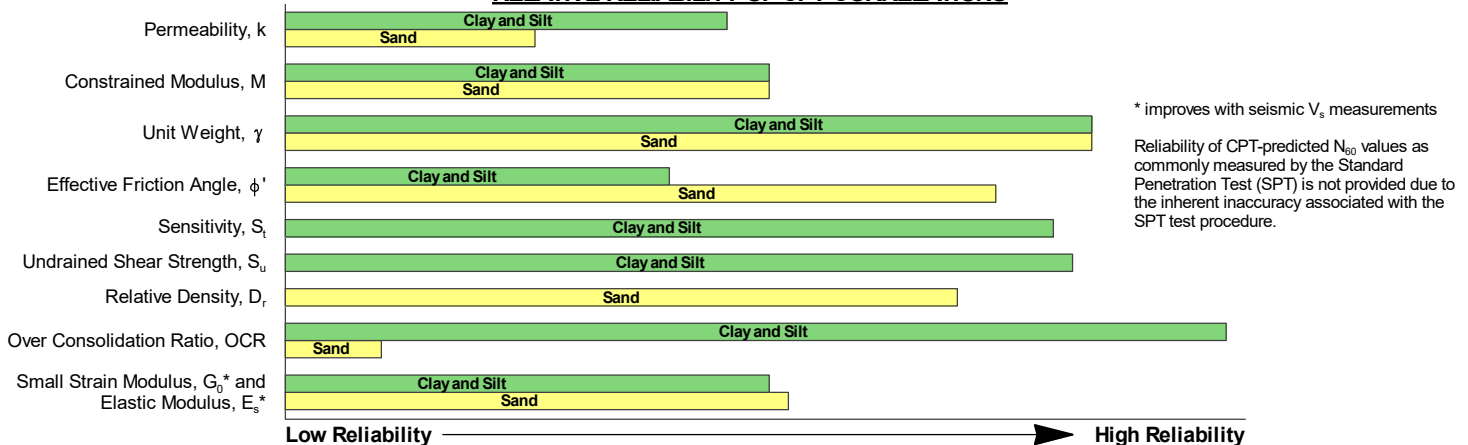
Relative Density,  $D_r$

$D_r = (Q_{tn} / 350)^{0.5} \times 100$

#### REPORTED PARAMETERS

CPT logs as provided, at a minimum, report the data as required by ASTM D5778 and ASTM D7400 (if applicable). This minimum data include  $q_t$ ,  $f_s$ , and  $u$ . Other correlated parameters may also be provided. These other correlated parameters are interpretations of the measured data based upon published and reliable references, but they do not necessarily represent the actual values that would be derived from direct testing to determine the various parameters. To this end, more than one correlation to a given parameter may be provided. The following chart illustrates estimates of reliability associated with correlated parameters based upon the literature referenced below.

#### RELATIVE RELIABILITY OF CPT CORRELATIONS



#### WATER LEVEL

The groundwater level at the CPT location is used to normalize the measurements for vertical overburden pressures and as a result influences the normalized soil behavior type classification and correlated soil parameters. The water level may either be "measured" or "estimated:"

*Measured - Depth to water directly measured in the field*

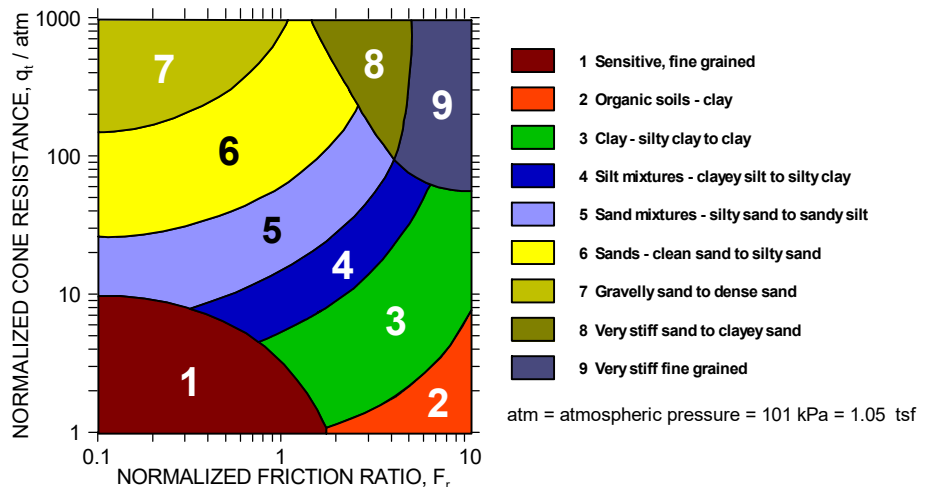
*Estimated - Depth to water interpolated by the practitioner using pore pressure measurements in coarse grained soils and known site conditions*

While groundwater levels displayed as "measured" more accurately represent site conditions at the time of testing than those "estimated," in either case the groundwater should be further defined prior to construction as groundwater level variations will occur over time.

#### CONE PENETRATION SOIL BEHAVIOR TYPE

The estimated stratigraphic profiles included in the CPT logs are based on relationships between corrected tip resistance ( $q_t$ ), friction resistance ( $f_s$ ), and porewater pressure ( $u_2$ ). The normalized friction ratio ( $F_r$ ) is used to classify the soil behavior type.

Typically, silts and clays have high  $F_r$  values and generate large excess penetration porewater pressures; sands have lower  $F_r$ 's and do not generate excess penetration porewater pressures. The adjacent graph (Robertson *et al.*) presents the soil behavior type correlation used for the logs. This normalized SBT chart, generally considered the most reliable, does not use pore pressure to determine SBT due to its lack of repeatability in onshore CPTs.



#### REFERENCES

- Kulhawy, F.H., Mayne, P.W., (1997). "Manual on Estimating Soil Properties for Foundation Design," Electric Power Research Institute, Palo Alto, CA.
- Mayne, P.W., (2013). "Geotechnical Site Exploration in the Year 2013," Georgia Institute of Technology, Atlanta, GA.
- Robertson, P.K., Cabal, K.L., (2012). "Guide to Cone Penetration Testing for Geotechnical Engineering," Signal Hill, CA.
- Schmertmann, J.H., (1970). "Static Cone to Compute Static Settlement over Sand," *Journal of the Soil Mechanics and Foundations Division*, 96(SM3), 1011-1043.

Unified Soil Classification System

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests <sup>A</sup>				Soil Classification	
				Group Symbol	Group Name <sup>B</sup>
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines <sup>C</sup>	Cu ≥ 4 and 1 ≤ Cc ≤ 3 <sup>E</sup>	GW	Well-graded gravel <sup>F</sup>
			Cu < 4 and/or [Cc < 1 or Cc > 3.0] <sup>E</sup>	GP	Poorly graded gravel <sup>F</sup>
		Gravels with Fines: More than 12% fines <sup>C</sup>	Fines classify as ML or MH	GM	Silty gravel <sup>F, G, H</sup>
			Fines classify as CL or CH	GC	Clayey gravel <sup>F, G, H</sup>
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines <sup>D</sup>	Cu ≥ 6 and 1 ≤ Cc ≤ 3 <sup>E</sup>	SW	Well-graded sand <sup>I</sup>
			Cu < 6 and/or [Cc < 1 or Cc > 3.0] <sup>E</sup>	SP	Poorly graded sand <sup>I</sup>
		Sands with Fines: More than 12% fines <sup>D</sup>	Fines classify as ML or MH	SM	Silty sand <sup>G, H, I</sup>
			Fines classify as CL or CH	SC	Clayey sand <sup>G, H, I</sup>
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	PI > 7 and plots above "A" line <sup>J</sup>	CL	Lean clay <sup>K, L, M</sup>
			PI < 4 or plots below "A" line <sup>J</sup>	ML	Silt <sup>K, L, M</sup>
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OL	Organic clay <sup>K, L, M, N</sup> Organic silt <sup>K, L, M, O</sup>
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay <sup>K, L, M</sup>
			PI plots below "A" line	MH	Elastic silt <sup>K, L, M</sup>
		Organic:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	OH	Organic clay <sup>K, L, M, P</sup> Organic silt <sup>K, L, M, Q</sup>
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

<sup>A</sup> Based on the material passing the 3-inch (75-mm) sieve.

<sup>B</sup> If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

<sup>C</sup> Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

<sup>D</sup> Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

<sup>E</sup>  $Cu = D_{60}/D_{10}$      $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

<sup>F</sup> If soil contains ≥ 15% sand, add "with sand" to group name.

<sup>G</sup> If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

<sup>H</sup> If fines are organic, add "with organic fines" to group name.

<sup>I</sup> If soil contains ≥ 15% gravel, add "with gravel" to group name.

<sup>J</sup> If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

<sup>K</sup> If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

<sup>L</sup> If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

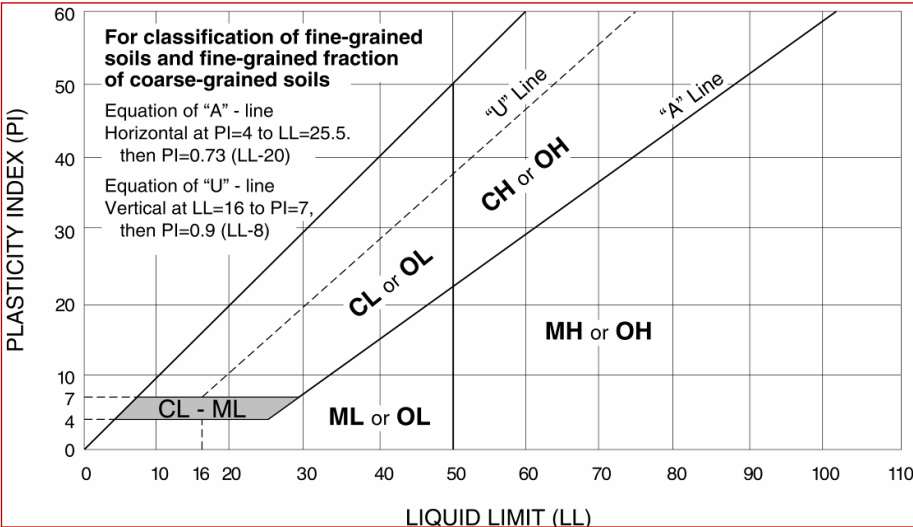
<sup>M</sup> If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

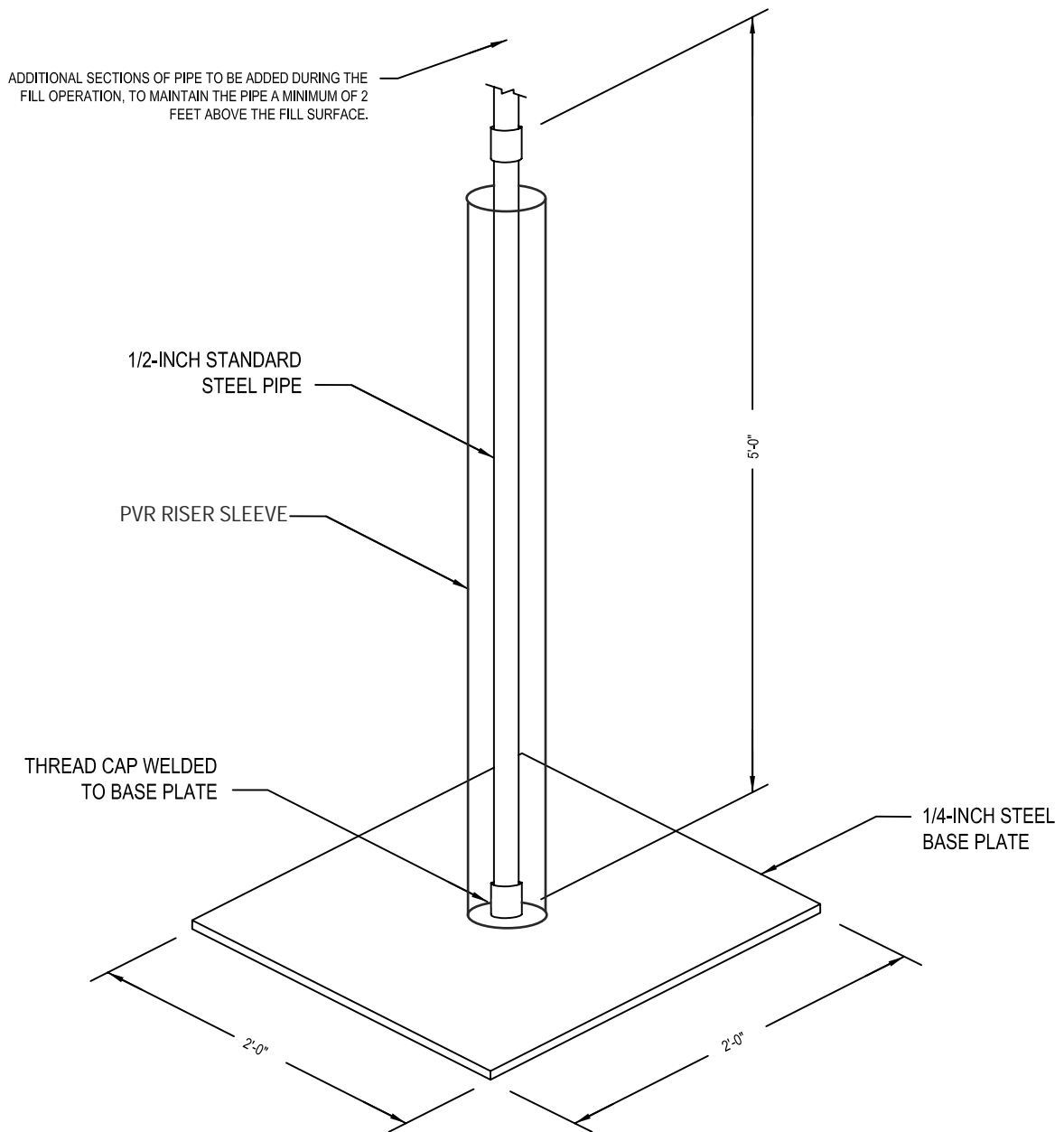
<sup>N</sup> PI ≥ 4 and plots on or above "A" line.

<sup>O</sup> PI < 4 or plots below "A" line.

<sup>P</sup> PI plots on or above "A" line.

<sup>Q</sup> PI plots below "A" line.





**NOTES:**

1. A 2-INCH-DIAMETER PVC SLEEVE SHALL BE PLACED AROUND THE VERTICAL METAL PIPE AND ADDED SECTIONS.
2. THE BASE PLATE SHALL BE PLACED PRIOR TO FILL PLACEMENT. A SAND PAD SHALL BE USED IF THE SURFACE IS NOT LEVEL.
3. THE PLATE, VERTICAL PIPE, AND PVC RISER SLEEVE SHALL BE PROTECTED BY BARRICADES OR OTHER DEVICES. DAMAGED OR DISTURBED SETTLEMENT PLATES AND PIPES SHALL BE REPLACED IMMEDIATELY BY INSTALLING A NEW PLATE IN THE SAME AREA AS RECOMMENDED BY THE GEOTECHNICAL ENGINEER.

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

NOT TO SCALE

Project Mngr:	MPD	Project No.	K6235038	TYPICAL SETTLEMENT PLATE		FIG. No.
Drawn By:	JLD	Scale:	AS SHOWN			
Checked By:	MPD	File No.		<b>Geotechnical Engineering Report</b> NC Maritime Museum  Beaufort, NC		SP
Approved By:	JLD	Date:	6/26/2023			
			 2108 Capital Drive, Wilmington, NC			



July 30, 2023

Terracon Consultants, Inc.  
2108 Capital Drive, Suite 103  
Wilmington, NC 28405

Attention: Mr. Justin DeNicola, P.E.

**Subject: Stormwater Soil Evaluations**  
**Project No. 23-033-SS**  
NC Maritime Museum  
West Beaufort Road Extension  
Beaufort, NC

Dear Mr. DeNicola:

Terrain Environmental Consulting, PLLC (Terrain) appreciates the opportunity to provide you with this report for stormwater soil evaluation services associated with the design of stormwater control measures (SCMs) at the above referenced project site. The results of the testing are presented below.

## **PROJECT BACKGROUND**

Terrain was contracted by Terracon to perform soil evaluation services, specifically seasonal high water table (SHWT) evaluation and hydraulic conductivity (Ksat) testing, to assist with the future design of SCMs at the above referenced project site. An aerial photograph showing six test locations (P-1 through P-6) was provided and the test locations were marked in the field prior to our mobilization. It is our understanding that permeable pavement is anticipated to be used as the SCM.

Review of the Web Soil Survey showed the areas at the test locations are mapped with the Augusta soil series which is generally described as somewhat poorly drained soil formed in loamy alluvial sediments on stream terraces with an expected SHWT between 12 to 24 inches below the ground surface.

## **RESULTS**

### Seasonal High Water Table Evaluation

The SHWT evaluations were performed on July 25, 2023 by advancing hand auger borings at the test locations (P-1 through P-6), as shown on the attached Stormwater Soil Evaluation sketch (**Figure 1**). The hand auger borings were advanced to depths ranging from approximately 15 to 30 inches below the existing ground surface. Soils were evaluated by a Licensed Soil Scientist for evidence of SHWT influence. This evaluation involved looking at the actual moisture content in the soil and observing the

matrix and mottle colors. Depending on the soil texture, the soil color will indicate processes that are driven by SHWT fluctuations such as iron reduction and oxidation and organic matter staining.

Apparent fill material was encountered at each location except for P-5. The fill consisted of sandy loam to sandy clay textured soils with shell fragments and rocks observed, and varied in thickness from 7 inches to 22 inches. Soils beneath the apparent fill consisted of buried root mats and organics at P-1, P-4 and P-6 or loamy sands transitioning to clayey soils beneath. At P-5, soils consisted of sandy loam surface over loamy sands. Auger refusal was encountered at P-3 and P-5 at 19 inches and 15 inches, respectively. We attempted to perform offset hand auger borings at these locations but encountered auger refusal at the offset locations as well. At P-3, auger refusal seemed to be due to buried rocks and bricks/terra cotta. At P-5, auger refusal appeared to be due to marl. We could not determine if the marl is naturally occurring but the surface elevation at the test location was approximately equal with the ground surface elevation in adjacent wooded areas where fill material was not observed, thus we assumed it was not fill material.

The SHWT ranged from 3 inches to 8 inches. Table 1 below provides the SHWT at each test location. A Soil Profile Description sheet, which provides a description of the observed soil horizons and the estimated SHWT depth, has also been included with this report.

### Ksat Testing

Terrain personnel performed in-situ saturated hydraulic conductivity (Ksat) testing at the test locations after the SHWT evaluations were complete. Specifically, the constant-head well permeameter technique (also known as shallow well pump-in technique and bore hole permeameter method) was used. This procedure is described in Methods of Soil Analysis, Part 1., Chapter 29 – Hydraulic Conductivity of Saturated Soils: Field Methods, 29 – 3.2 Shallow Well Pump In Method, pp. 758-763 and in the Soil Science Society of America Journal, Vol. 53, no. 5, Sept. – Oct. 1989, “A Constant-head Permeameter for Measuring Saturated Hydraulic Conductivity of the Vadose Zone” and “Comparison of the Glover Solution with the Simultaneous – Equations Approach for Measuring Hydraulic Conductivity.” This method involves allowing a measured volume of water to percolate through the soil until a steady rate of flow is achieved. The steady state rate is used to calculate the Ksat of the soil horizon using the Glover equation.

Due to the shallow SHWTs, the Ksat testing was performed immediately below the existing ground surface. The Ksat rates were calculated as ranging between 0.51 inches per hour (in/hr) to 1.36 in/hr.

See Table 1 below for a summary of the soil evaluation results.

TABLE 1				
TEST LOCATION	SHWT (inches below ground surface)	OWT (inches below the ground surface)	Testing Interval (inches below ground surface)	Ksat RATE (inches per hour)
P-1	8 inches	26 inches	2 to 8 inches	1.36 in/hr
P-2	6 inches	22 inches	2 to 8 inches	0.57 in/hr
P-3	8 inches	Not Observed	1 to 7 inches	0.60 in/hr
P-4	3 inches	Not Observed	1 to 7 inches	0.60 in/hr
P-5	4 inches	Not Observed	2 to 8 inches	0.51 in/hr
P-6	7 inches	Not Observed	2 to 8 inches	0.70 in/hr

## DISCUSSION

Permeable pavement requires a two-foot separation between the bottom of the pavement section and the SHWT. Due to the shallow SHWTs observed across the site, it is likely that fill material will be needed to create the required separation. Site grading activities may result in compaction of the existing soils which could reduce their Ksat rates. Scarifying and/or deep chiseling the existing soil prior to placement fill could help to reduce the effects of compaction from heavy machinery. Additionally, compaction of fill material placed to create the required two-foot separation could also result in stormwater infiltrating slower than the Ksat rates provided in Table 1. Limiting compaction of fill material in the permeable pavement areas and/or deep chiseling/scarifying the fill in these areas could help to reduce the compaction effects from heavy machinery as well. We recommend discussing these conditions and possible mitigation measures with the site grading contractor prior to starting grading activities.

## CLOSING

We appreciate the opportunity to provide stormwater soil evaluation services. If you have any questions, please do not hesitate to contact me.

Sincerely,



Paul Masten, LSS, PWS  
President/Owner

Attachments

Figure 1 – Stormwater Soil Evaluations  
Soil Profile Descriptions







**SOIL PROFILE DESCRIPTIONS**  
**NC Maritime Museum**  
**West Beaufort Road Extension**  
**Beaufort, NC**

Location	Horizon	Depth (inches)	Matrix	Mottles	Texture, Structure, Consistence
P-1	Fill	0-8	10YR 2/2		Very dark brown loamy sand, granular, very friable, rocks and shell fragments present
	Fill	8-14	10YR 5/1	10YR 5/8	Gray sandy loam, weak, fine sub-angular blocky, friable, clay pieces present; common yellowish brown redox concentrations
	Fill	14-22	2.5Y 4/3	10YR 5/1 10YR 5/8	Olive brown sandy clay, strong, medium sub-angular blocky, sticky, plastic, firm; common gray redox depletions and yellowish brown redox concentrations
	Ab	22-28	10YR 2/1	10YR 4/1	Black sandy loam, moderate, medium angular blocky, friable, buried roots and organics; common dark gray redox depletions
Seasonal High Water Table = 8 inches below the existing ground surface. Water table observed at 26 inches below the ground surface.					

**SOIL PROFILE DESCRIPTIONS**  
**NC Maritime Museum**  
**Page 2**

Location	Horizon	Depth (inches)	Matrix	Mottles	Texture, Structure, Consistence
P-2	Fill	0-6	10YR 2/2		Very dark brown loamy sand, granular, very friable, shell fragments present
	Fill	6-9	10YR 3/1	10YR 5/1 10YR 5/8	Very dark gray sandy loam, weak, fine angular blocky, friable, shell fragments present; common gray redox depletions and yellowish brown redox concentrations
	E	9-19	2.5Y 5/2	2.5Y 5/3 10YR 5/8 2.5Y 4/1	Grayish brown loamy sand, granular, very friable; common light olive brown to yellowish brown redox concentrations and dark gray redox depletions
	Btg	19-30	2.5Y 2.5/1	2.5Y 4/1 10YR 5/8	Black sandy clay loam, moderate, medium sub-angular blocky, sticky, plastic, firm; common dark gray redox depletions and yellowish brown redox concentrations
Seasonal High Water Table = 6 inches below the existing ground surface. Water table observed at 22 inches below the ground surface.					
P-3	Fill	0-8	10YR 2/2		Very dark brown loamy sand, granular, very friable
	Fill	8-19	10YR 3/1	10YR 6/1 10YR 5/8 10YR 2/1	Very dark gray sandy loam, weak, fine angular blocky, friable; common gray redox depletions, yellowish brown redox concentrations and black organic accumulations, rocks, shells and brick pieces present. Auger refusal at 19 inches
Seasonal High Water Table = 8 inches below the existing ground surface.					

**SOIL PROFILE DESCRIPTIONS**  
**NC Maritime Museum**  
**Page 3**

<b>Location</b>	<b>Horizon</b>	<b>Depth (inches)</b>	<b>Matrix</b>	<b>Mottles</b>	<b>Texture, Structure, Consistence</b>
P-4	Fill	0-3	10YR 2/2		Very dark brown loamy sand, granular, very friable
	Fill	3-12	2.5Y 7/2	2.5Y 6/2 10YR 5/8	Light gray fine sand, single grain, loose; common light grayish brown redox depletions and yellowish brown redox concentrations
	Ab	12-14	7.5YR 2.5/1		Black sandy loam, granular, friable, buried roots and organics
	E1	14-17	10YR 4/2	10YR 5/6	Dark grayish brown loamy sand, weak, medium angular blocky, friable; common yellowish brown redox concentrations
	E2	17-25	2.5Y 6/2	10YR 5/8 2.5Y 6/4	Light brownish gray loamy sand, granular, very friable, shell fragments present; common yellowish brown to light yellowish brown redox concentrations
	C	25-30	2.5Y 6/2	2.5Y 4/1 10YR 5/8	Light brownish gray sandy clay, massive, sticky, plastic, firm; common dark gray organic accumulations and yellowish brown redox concentrations
Seasonal High Water Table = 3 inches below the existing ground surface.					
P-5	A	0-4	10YR 2/2		Very dark brown loamy sand, granular, very friable
	E	4-15	10YR 5/1	10YR 4/1 10YR 5/8	Gray loamy sand, granular, very friable, marl and shell fragments present; common dark gray organic accumulations and yellowish brown redox concentrations. Auger regular at 15 inches.
Seasonal High Water Table = 4 inches below the existing ground surface.					

**SOIL PROFILE DESCRIPTIONS**  
**NC Maritime Museum**  
**Page 4**

<b>Location</b>	<b>Horizon</b>	<b>Depth (inches)</b>	<b>Matrix</b>	<b>Mottles</b>	<b>Texture, Structure, Consistence</b>
P-6	Fill	0-7	10YR 4/2		Dark grayish brown sandy loam, granular, friable
	Ab	7-15	10YR 2/1	10YR 5/1 10YR 5/8	Black sandy loam, moderate, medium sub-angular blocky, friable; common gray redox depletions and yellowish brown redox concentrations
	Btg	15-26	10YR 5/1	10YR 6/3 10YR 5/8 10YR 4/1	Gray sandy clay, strong, medium sub-angular blocky, sticky, plastic, firm; common pale brown to yellowish brown redox concentrations and dark gray organic accumulations
Seasonal High Water Table = 7 inches below the existing ground surface.					