# SURFSIDE 96th STREET PARK

## PROJECT MANUAL

May 2022

savinomiller DESIGN STUDIO


Owner:
**Town of Surfside**
9293 Harding Avenue
Surfside, FL 33154

Prime Consultant and Landscape Architect:
**Savino & Miller Design Studio**
12345 NE 6th Avenue Suite A
North Miami, FL 33161

Architect:
**William Lane Architecture, Inc.**
1480 Marseille Drive
Miami Beach, Florida 33141

Civil & Coastal Engineering:
**Coastal Systems International, Inc.**
464 S. Dixie Highway
Coral Gables, FL 33146

Structural Engineer:
**Douglas Wood Associates, Inc.**
5040 N.W. 7th Street, Suite 820
Miami, FL 33155

MEP Engineer:
**Louis J. Aguirre & Assoc.**
9150 South Dadeland Blvd.
Miami, Florida 33156

Survey and GIS:
**3TCI, Inc**
12211 S.W. 129 Ct.
Miami, Fl 33186

Geotechnical Engineer:
**Ardaman & Associates**
2608 W. 84th Street
Hialeah, Fl. 33016

Environmental Engineering:
**Gallagher Bassett Technical Services**
2700 West Cypress Creek Rd,
Suite D-122
Fort Lauderdale, FL 33309

Arborist:
**Tropical Designs of Florida**
P.O. Box 5177
Village of Pinecrest, FL 33256

Irrigation Consultant:
**Kenneth Di Donato, Inc.**
2212 Hollywood Blvd.
Hollywood, FL 33020

LEED/SITES Consultants:
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175 SE 1st Ave.
Delray Beach, FL 33444

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SECTION RESPONSIBILITY KEY

[LA] Landscape Architect (Design Professional of Record - DPOR)
[AR] Architect
[SE] Structural Engineer
[CE] Civil Engineer
[PL] Plumbing Engineer
[HV] HVAC Engineer
[EL] Electrical Engineer

END OF TABLE OF CONTENTS

# SECTION 024113 – SELECTIVE SITE DEMOLITION

## PART 1 - GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ANSI/ASSP A10.6-2006 (R2016) Safety and Health Program Requirements for Demolition Operations

### 1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from the Owner. Remove rubbish and debris from the project site. Store materials that cannot be removed daily in areas specified by the Owner.

### 1.3 SUBMIITALS

1. Preconstruction Submittals:

    a. Demolition Plans
    b. Existing Conditions

2. Certificates:

    a. Notification of Demolition and Renovation Form

3. Closeout Submittals:

    a. Receipts

### 1.4 REQULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations. Safety requirements shall conform to ASSP A10.6.

### 1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris and avoid the creation of a nuisance in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to pollution. Sweep pavements as often as necessary to control the spread of debris.

1.6 PROTECTION

A. Traffic Control Signs

Where pedestrian and driver safety are endangered in the area of removal work, use traffic barricades with flashing lights and other safety fencing as applicable. Notify the Owner prior to beginning such work.

B. Existing Work

Protect existing work, which is to remain in place, be reused, or remain the Project site. Repair items, which are to remain, which are to be salvaged and which are damaged during performance of the work to their original condition or replace with new at the discretion of the Owner. Do not overload pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition or removal work. Repairs, reinforcement, or structural replacement must have Owner approval.

C. Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

1.7 BURNING

Burning will not be permitted.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair items to be relocated, which are damaged or replace damaged items with new undamaged items as approved by the Owner.

1.9 REQUIRED DATA

Demolition plan shall include procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services.

**PART 2 - EXECUTION**

2.1 EXISTING FACILITIES TO BE REMOVED

A. Structures

Remove existing structures indicated to be removed to the specified elevations.

B. Utilities and Related Equipment

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Owner. Remove meters and related equipment and deliver to a location in accordance with instructions of the Owner. If utility lines are encountered that are not shown on drawings, contact the Owner for further instructions.

C. Paving and Slabs

Remove ground sawcut concrete and asphaltic concrete paving and slabs as indicated to a depth of 6 inches below existing adjacent grade. Provide neat sawcuts at limits of pavement removal as indicated.

D. Concrete

Saw concrete along straight lines to a depth of not less than 2 inches. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

E. Patching

1. Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish.
2. Patching shall be as specified and indicated, and shall include holes and depressions caused by previous physical damage or left as a result of removals in existing masonry walls to remain, shall be completely filled with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

F. Abandoned Utilities

Remove aboveground utilities and terminate as approved by the Owner. Remove necessary portions of underground utilities to within 24 inches of excavation or final grade. Cap off conduits with minimum 24-inch-long concrete plugs. Remove all inactive valves.

## 2.2 CONCURRENT EARTH MOVING

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or deconstruction work in areas occupied by structures to be demolished or deconstructed until all demolition and deconstruction in the area has been completed and debris removed. Fill holes, open basements, and other hazardous openings.

## 2.3 DISPOSITION OF MATERIAL

A. Title to Materials

Except where specified in other sections, all materials and equipment removed, and not reused, shall become the property of the Contractor, and shall be removed from Project Site. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Owner and removal procedures, and authorization by the Owner to begin

demolition. The Owner will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

B. Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage and reinstall as the work progresses. The engineer in writing must approve reuse of any material.

C. Salvaged Materials and Equipment

Remove materials and equipment that are to remain the property of the Client and deliver to a storage site.

2.4 CLEANUP

Remove and transport debris and rubbish in a manner that will prevent spillage on pavements, streets or adjacent areas. Clean up spillage from pavements, streets, and adjacent areas to prevent FOD potential.

2.5 DISPOSAL OF REMOVED MATERIALS

A. Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified.

END OF SECTION

# SECTION 031000 - CONCRETE FORMING 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. Form-facing material for cast-in-place concrete.

2. Shoring, bracing, and anchoring.

### 1.3 DEFINITIONS

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

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

### 1.4 PREINSTALLATION MEETINGS

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

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.

b. Construction, movement, contraction, and isolation joints

c. Forms and form-removal limitations.

d. Shoring and reshoring procedures.

e. Anchor rod and anchorage device installation tolerances.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Concealed surface form-facing material.

2. Form ties.

3. Waterstops.

4. Form-release agent.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: Contractor is responsible for engage and pay for testing and inspection agency.

B. Contractor is responsible for engage and pay the field quality-control reports.

C. Minutes of preinstallation conference.

D. Field quality-control reports.

## 1.7 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: Contractor is responsible for engage and pay an independent agency, **acceptable to authorities having jurisdiction**, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

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

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."

2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

## 2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.

2. Furnish in largest practicable sizes to minimize number of joints.

3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

a. Plywood, metal, or other approved panel materials.

b. Exterior-grade plywood panels, suitable for concrete forms complying with DOC PS 1.

## 2.3 WATERSTOPS

A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.

B. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

## 2.4 RELATED MATERIALS

A. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

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

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

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

2. Form release agent for form liners shall be acceptable to form liner manufacturer.

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

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

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

# PART 3 - EXECUTION

## 3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).

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

1. Minimize joints.

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

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.

2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

3. Install keyways, reglets, recesses, and other accessories, for easy removal.

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

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

1. Provide and secure units to support screed strips

2. Use strike-off templates or compacting-type screeds.

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

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.

2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

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

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

1. Determine sizes and locations from trades providing such items.

2. Obtain written approval of Engineer on Record prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.

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

3. Place joints perpendicular to main reinforcement.

4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

   a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.

2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

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

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

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

## 3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3. Install dovetail anchor slots in concrete structures, as indicated on Drawings.

4. Clean embedded items immediately prior to concrete placement.

## 3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.

2. Locate waterstops in center of joint unless otherwise indicated on Drawings.

3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."

4. Secure waterstops in correct position at 12 inches on center.

5. Clean waterstops immediately prior to placement of concrete.

6. Support and protect exposed waterstops during progress of the Work.

## 3.4 REMOVING AND REUSING FORMS

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

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 80 percent of its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

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

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.

2. Apply new form-release agent.

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

1. Align and secure joints to avoid offsets.

2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

## 3.5 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

## 3.6 FIELD QUALITY CONTROL

A. Special Inspections: Contractor is responsible for engage and pay a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Contractor is responsible for engage and pay a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

**END OF SECTION 03 10 00**

# SECTION 032000 - CONCRETE REINFORCING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and General provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Section, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.

2. Welded-wire reinforcement.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.

b. Construction contraction and isolation joints.

c. Steel-reinforcement installation.

### 1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.

2. Bar supports.

3. Mechanical splice couplers.

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

1. Include placing drawings that detail fabrication, bending, and placement.

2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

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

1. Location of construction joints is subject to approval of Engineer on Record.

## 1.5 INFORMATIONAL SUBMITTALS

A. Contractor is responsible for engage and pay to a testing and inspection agency.

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

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM a706.

2. Mechanical splice couplers.

C. Field quality-control reports.

D. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4.

E. Minutes of preinstallation conference.

## 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Contractor is responsible for engage and pay to an independent agency, **acceptable to authorities having jurisdiction,** qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage **and to avoid damaging coatings on steel reinforcement**.

1. Store reinforcement to avoid contact with earth.

# PART 2 - PRODUCTS

## 2.1 STEEL REINFORCEMENT

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

B. Low-Alloy Steel Reinforcing Bars: ASTM A706, deformed.

C. Galvanized Reinforcing Bars:

1. Steel Bars: ASTM A615, Grade 60, deformed bars.

2. Zinc Coating: ASTM A767, Class I zinc coated after fabrication and bending.

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

E. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064, plain, fabricated from galvanized-steel wire into flat sheets.

## 2.2 REINFORCEMENT ACCESSORIES

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

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

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

b. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

B. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; tension-compression-only dowel-bar type.

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

1. Finish: Plain.

D. Zinc Repair Material: ASTM A780.

## 2.3 FABRICATING REINFORCEMENT

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

# PART 3 - EXECUTION

## 3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.

2. Repair damage and reseal vapor retarder before placing concrete.

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

## 3.2 INSTALLATION OF STEEL REINFORCEMENT

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

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

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.

2. Do not tack weld crossing reinforcing bars.

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

D. Provide concrete coverage in accordance with ACI 318.

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

F. Splices: Lap splices as indicated on Drawings.

1. Stagger splices in accordance with ACI 318.

2. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

3. Weld reinforcing bars in accordance with AWS D1.4, where indicated on Drawings.

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

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

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire.

3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

4. Lace overlaps with wire.

H. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material in accordance with ASTM A780.

## 3.3 JOINTS

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

1. Place joints perpendicular to main reinforcement.

2. Continue reinforcement across construction joints unless otherwise indicated.

3. Do not continue reinforcement through sides of strip placements of floors and slabs.

## 3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

## 3.5 FIELD QUALITY CONTROL

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

**END OF SECTION 03 20 00**

# 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 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.

2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

## 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 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. Vapor-retarder installation.

d. Anchor rod and anchorage device installation tolerances.

e. Hot weather concreting procedures.

f. Concrete finishes and finishing.

g. Curing procedures.

h. Forms and form-removal limitations.

i. Shoring and reshoring procedures.

j. Methods for achieving specified floor and slab flatness and levelness.

k. Floor and slab flatness and levelness measurements.

l. Concrete protection.

m. Initial curing and field curing of field test cylinders (ASTM C31.)

n. Protection of field cured field test cylinders.

## 1.4 ACTION SUBMITTALS

A. 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. Slump limit.

6. Air content.

7. Nominal maximum aggregate size.

8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.

## 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. Curing compounds.

4. Bonding agents.

5. Adhesives.

6. Vapor retarders.

C. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

## 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.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 requirements for production facilities and equipment.

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.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94 and ACI 301.

## 1.8 FIELD CONDITIONS

A. 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.

## 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. Form-facing materials.

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I.

2. Fly ash: ASTM C618, Class F.

3. Slag Cement: ASTM C989, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C33.

D. Air-Entraining Admixture: ASTM C260.

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, Type A.

2. Retarding Admixture: ASTM C494, Type B.

3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.

4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.

5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.

6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

F. Water and Water Used to Make Ice: ASTM C94, potable or complying with ASTM C1602.

G. Steel Reinforcement:

1. Reinforcing Bars: All bars deformed and galvanized as indicated in the structural drawings.

2. Welded Wire reinforcement.

## 2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, with maximum water-vapor permeance of 0.1 perms or less if recommended by floor finish manufacturer; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

## 2.4 CURING MATERIALS

A. Water: Potable or complying with ASTM C1602.

B. 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, ASTM D1752, cork or self-expanding cork.

## 2.6 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: 40 percent by mass.

2. Slag Cement: 50 percent by mass.

3. Silica Fume: 10 percent by mass.

4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use water-reducing admixture in pumped concrete.

## 2.7 CONCRETE MIXTURES

1. Minimum Compressive Strength:

    1. 5000 psi at 28 days.

## 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 (150 mm), 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.

## 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. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. 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.

2. 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.

## 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 Engineer on Record, 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 E.O.R in writing.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

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 (38 mm) wide or 1/2 inch (13 mm) deep.

b. Remove projections larger than 1 inch (25 mm).

c. Tie holes do not require patching.

d. Surface Tolerance: ACI 117 Class D.

## 3.8 FINISHING FLOORS AND SLABS

A. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.

2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.

2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.

2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

4. Do not add water to concrete surface.

5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.

a. 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 and also no more than 1/16 inch in 2 feet (610 mm)].

2) Specified overall values of flatness, $F_F$ = 50.

D. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces 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 finish to concrete stair treads, platforms, ramps as indicated on architectural drawings.

G. Dry-Shake Floor Hardener Finish: As required by architectural drawings.

**3.9 CONCRETE CURING**

A. Protect freshly placed concrete from premature drying and excessive hot temperatures.

1. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.

2. Maintain moisture loss no more than 0.2 lb/sq. ft. x h calculated in accordance with ACI 305.1, before and during finishing operations.

**3.10 TOLERANCES**

A. Conform to ACI 117.

**3.11 FIELD QUALITY CONTROL**

A. Special Inspections: Contractor will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Contractor will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

**END OF SECTION 03 30 00**

**SECTION 033300**

**ARCHITECTURAL CONCRETE**

## 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 cast-in-place architectural concrete, including form facings, reinforcement and accessories, concrete materials, concrete mixture design, placement procedures, and finishes.

1. Requirements in Section 033000 "Cast-in-Place Concrete" apply to architectural concrete.

1.3 DEFINITIONS

A. Cast-in-Place Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified architectural appearance.

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

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

D. Reveal: Projection of coarse aggregate from matrix or mortar after completion of exposure operations.

E. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place architectural 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. Cast-in-place architectural concrete Subcontractor.

2. Review concrete finishes and finishing, hot-weather concreting procedures, curing procedures, construction joints, forms and form-removal limitations, reinforcement accessory installation, concrete repair procedures, and protection of cast-in-place architectural concrete.
3. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials.

## 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Formwork Shop Drawings: Show formwork construction, including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.

D. Placement Schedule: Submit concrete placement schedule before start of placement operations. Include locations of all joints, including construction joints.

E. Samples: For each of the following materials:

1. Form-facing panels.
2. Form ties.
3. Form liners.
4. Exposed aggregates.
5. Coarse- and fine-aggregate gradations.
6. Chamfers and rustications.

F. Samples for Verification: Architectural concrete Samples, cast vertically, approximately 18 by 18 by 2 inches (450 by 450 by 50 mm), of finishes, colors, and textures to match design reference sample. Include Sample sets showing the full range of variations expected in these characteristics.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, manufacturer, and testing agency.

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

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Repair materials.

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

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity**.**

1.7 QUALITY ASSURANCE

A. 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 according to NRMCA's "NRMCA Quality Control Manual - Section 3, Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

C. Mockups: Before casting architectural concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build mockups of typical exterior wall of cast-in-place architectural concrete as shown on Drawings.
3. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
4. In presence of Architect, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
5. Obtain Architect's approval of mockups before casting architectural concrete.
6. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents.
4. Do not use chemical accelerators unless otherwise specified and approved in design mixtures.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301 (ACI 301M).
2. ACI 303.1.

### 2.2 FORM-FACING MATERIALS

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for formwork and other form-facing material requirements.

B. Source Limitations: Obtain each type form-facing material from single source from single manufacturer.

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

D. Form Joint Tape: Compressible foam tape; pressure sensitive; AAMA 800; minimum 1/4 inch (6 mm) thick.

E. Form Joint Sealant: Elastomeric sealant complying with ASTM C920, Type M or Type S, Grade NS, that adheres to form joint substrates.

F. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleed water and prevent migration of set-retarding chemicals from wood.

G. Form-Release Agent: Commercially formulated, colorless form-release agent that will not bond with, stain, or adversely affect architectural concrete surfaces and will not impair subsequent treatments of those surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

H. Surface Retarder: Chemical liquid set retarder, for application on form-facing materials, capable of temporarily delaying final hardening of newly placed concrete surface to depth of reveal specified.

2.3 STEEL REINFORCEMENT AND ACCESSORIES

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for steel reinforcement and other requirements for reinforcement accessories.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice."

1. Where legs of wire bar supports contact forms, use all-plastic bar supports.

2.4 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, Type II, Type I/II, Type III, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

2. Silica Fume: ASTM C 94/C 94M and potable.

A. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: in accordance with ACI 318-14, section 26.4.1.2.1.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

B. Normal-Weight Fine Aggregate: ASTM C33/C33M, manufactured or natural sand, from same source for entire Project.

C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
7. Waterproofing Admixture: ASTM C494/C 494M.

D. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

E. Water: Potable, complying with ASTM C94/C94M, except free of wash water from mixer washout operations.

## 2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.
1. For integrally colored concrete, curing compound shall be approved by color pigment manufacturer.
2. For concrete indicated to be sealed, curing compound shall be compatible with sealer.

## 2.6 REPAIR MATERIALS

A. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C881/C881M two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements.
1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

## 2.7 CONCRETE MIXTURES

A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide cast-in-place architectural concrete of consistent quality in appearance and physical properties.

B. Prepare design mixtures for each type and strength of cast-in-place architectural concrete proportioned on basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).

1. Use a qualified independent testing agency for preparing and reporting proposed design mixtures based on laboratory trial mixtures.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

F. Concrete Mixtures:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) at 28 days.

2. Maximum W/C Ratio: 0.40.
3. Slump Limit: 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).

2.8 CONCRETE MIXING

A. Ready-Mixed Architectural Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94/C94M and furnish batch ticket information.

1. Clean equipment used to mix and deliver cast-in-place architectural concrete to prevent contamination from other concrete.
2. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

**PART 3 - EXECUTION**

3.1 FORMWORK INSTALLATION

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for formwork, embedded items, and shoring and reshoring.

B. Limit deflection of form-facing panels to not exceed ACI 303.1 requirements.

C. In addition to ACI 303.1 limits on form-facing panel deflection, limit cast-in-place architectural concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3 mm)

D. Construct forms to result in cast-in-place architectural concrete that complies with ACI 117 (ASI 117M).

1. Also comply with the following tolerances: +/- ”.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-in-place surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Seal form joints and penetrations at form ties with form joint tape or form joint sealant to prevent cement paste leakage.
2. Do not use rust-stained steel form-facing material.

F. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of cast-in-place architectural concrete.

H. Coat contact surfaces of chamfer strips with sealer before placing reinforcement, anchoring devices, and embedded items.

I. Form openings, chases, offsets, sinkages, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

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

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

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

M. Coat contact surfaces of forms with surface retarder, according to manufacturer's written instructions, before placing reinforcement.

N. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and attach securely to prevent deflection and maintain stability of liners during concreting. Prevent form liners from sagging and stretching in hot weather. Seal joints of form liners and form-liner accessories to prevent mortar leaks. Coat form liner with form-release agent.

## 3.2 REINFORCEMENT AND INSERT INSTALLATION

A. General: Comply with Section 033000 "Cast-in-Place Concrete" for fabricating and installing steel reinforcement. Securely fasten steel reinforcement and wire ties against shifting during concrete placement.

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

## 3.3 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Schedule form removal to maintain surface appearance that matches approved mockups.
2. Cut off and grind glass-fiber-reinforced plastic form ties flush with surface of concrete.

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

C. Clean and repair surfaces of forms to be reused in the Work. Do not use split, frayed, delaminated, or otherwise damaged form-facing material. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for cast-in-place architectural concrete surfaces.

3.4 JOINTS

A. Construction Joints: Install construction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect and Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete. Align construction joint within rustications attached to form-facing material.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
5. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

B. Contraction Joints: Form weakened-plane contraction joints true to line, with faces perpendicular to surface plane of cast-in-place architectural concrete, so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, form-release agent, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously between construction joints. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 303.1.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. Do not permit vibrators to contact forms.

3.6 FINISHES, GENERAL

A. Architectural Concrete Finish: Match Architect's design reference sample, identified and described as indicated, to satisfaction of Architect.

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces.

1. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

C. Maintain uniformity of special finishes over construction joints unless otherwise indicated.

## 3.7 AS-CAST FORMED FINISHES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections exceeding specified limits on formed-surface irregularities.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.

C. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Form-Liner Finish: Produce a textured surface free of pockets, streaks, and honeycombs, and of uniform appearance, color, and texture.

## 3.8 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with ACI 301 (ACI 301M) for hot-weather protection during curing.

B. Begin curing cast-in-place architectural concrete immediately after [**removing forms from**] [**applying as-cast formed finishes to**] concrete. Cure according to ACI 308.1, by one or a combination of the following methods that will not mottle, discolor, or stain concrete:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

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 (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Mist concrete surfaces with water. Apply curing compound uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

## 3.9 FIELD QUALITY CONTROL

A. General: Comply with field quality-control requirements in Section 033000 "Cast-in-Place Concrete."

## 3.10 REPAIR, PROTECTION, AND CLEANING

A. Repair and cure damaged finished surfaces of cast-in-place architectural concrete when approved by Architect. Match repairs to color, texture, and uniformity of surrounding surfaces and to repairs on approved mockups.

1. Remove and replace cast-in-place architectural concrete that cannot be repaired and cured to Architect's approval.

B. Protect corners, edges, and surfaces of cast-in-place architectural concrete from damage; use guards and barricades.

C. Protect cast-in-place architectural concrete from staining, laitance, and contamination during remainder of construction period.

D. Clean cast-in-place architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.

E. Wash and rinse surfaces according to concrete finish applicator's written instructions. Protect other Work from staining or damage due to cleaning operations.

1. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

**END OF SECTION 033300**

# SECTION 033523 – INTEGRALLY COLORED CONCRETE WITH EXPOSED SHELL

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to Work of this Section.

B. Section Includes:
   1. Integrally colored concrete
   2. Curing and sealing of integrally colored concrete.
   3. Exposed shell aggregate.

C. Related Sections:
   1. Division 3 Section "Cast-In-Place Concrete" for general applications of concrete and coordination of sample submittal [and color selection].

### 1.2 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 301 "Specification for Structural Concrete for Buildings."
   2. ACI 302 IR "Recommended Practice for Concrete Floor and Slab Construction."
   3. ACI 303.1 "Standard Specification for Cast-In-Place Architectural Concrete."
   4. ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing of Concrete."
   5. ACI 305R "Recommended Practice for Hot Weather Concreting."
   6. ACI 306R "Recommended Practice for Cold Weather Concreting."

B. American Society for Testing and Materials (ASTM):
   1. ASTM C309 "Liquid Membrane-Forming Compounds for Curing Concrete."
   2. ASTM C494 "Standard Specification for Chemical Admixtures for Concrete."
   3. ASTM C979 "Standard Specification for Pigments for Integrally Colored Concrete."

C. American Association of State Highway and Transportation Officials (AASHTO):
   1. AASHTO M194 "Chemical Admixtures."

### 1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s complete technical data sheets for the following:
   1. Colored admixture.
   2. Curing and Sealing compound.

B. Design Mixes: For each type of integrally colored concrete.

C. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available and selected samples.

D. Qualification Data: For firms indicated in "Quality Assurance" Article, including list of completed projects.

## 1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer with 10-years experience in the production of specified products.

B. Installer Qualifications: An installer with 5+ years experience with work of similar scope and quality.

C. Comply with the requirements of ACI 301.

D. Obtain each specified material from same source and maintain high degree of consistency in workmanship throughout Project.

E. Notification of manufacturer's authorized representative shall be given at least 1-week before start of Work.

F. Integrally Colored Concrete Mockups:
1. Provide under provisions of Division 1 Section "Quality Control."
2. At location at Project site, selected by Landscape Architect, place and finish 10 feet by 10 feet area.
3. For accurate color, the quantity of concrete mixed to produce the sample should not be less than 3 cubic yards (or not less than 1/3 the capacity of the mixing drum on the ready-mix truck) and should always be in full cubic yard increments. Excess material shall be discarded according to local regulations.
4. Construct mockup using processes and techniques intended for use on permanent work, including curing procedures. Include samples of control, construction, and expansion joints in sample panels. Mockup shall be produced by the individual workers who will perform the work for the Project.
5. Retain samples of cements, sands, aggregates and color additives used in mockup for comparison with materials used in remaining work.
6. Accepted mockup provides visual standard for work of Section.
7. Mockup shall remain through completion of work for use as a quality standard for finished work.
8. Remove mockup when directed by Landscape Architect or Town.

## 1.5 DELIVERY, STORAGE AND HANDLING

A. Colored Admixture: Comply with manufacturer's instructions. Deliver colored admixtures in original, unopened packaging. Store in dry conditions.

## 1.6 PROJECT CONDITIONS

A. Integrally Colored Concrete Environmental Requirements:
   1. Schedule placement to minimize exposure to wind and hot sun before curing materials are applied.
   2. Avoid placing concrete if rain is forecast within 24-hours. Protect fresh concrete from moisture.
   3. Comply with professional practices described in ACI 305R and ACI 306R.

B. Schedule delivery of concrete to provide consistent mix times from batching until discharge. Mix times shall meet manufacturer's written recommendations.

## 1.7 PRE-JOB CONFERENCE

A. One week prior to placement of integrally colored concrete a meeting will be held to discuss the Project and application materials.

B. It is suggested that the Landscape Architect, General Contractor, Subcontractor, Ready-Mix Concrete Representative, and a Manufacturer's Representative be present.

# PART 2 - PRODUCTS

## 2.1 ACCEPTABLE MANUFACTURER

A. SIKA Corporation, 625 West Illinois Avenue, Aurora, IL 60506. 800-282-3388

## 2.2 MATERIALS

A. Colored Admixture for Integrally Colored Concrete: SikaColor-120G Granular Integral Color (formerly CHROMIX G® Admixture; L.M. SCOFIELD COMPANY).
   1. Admixture shall be a colored, water-reducing, admixture containing no calcium chloride with coloring agents that are limeproof and ultra-violet resistant.
   2. Colored admixture shall conform to the requirements of ACI 303.1, ASTM C979, ASTM C494 and ASSHTO M194.

B. Curing and Sealing Compound: Cureseal-S™ Matte; L.M. SCOFIELD COMPANY. Curing and sealing compound shall comply with ASTM C309 and be of same manufacturer as colored admixture, for use with integrally colored concrete.

C. #2 / #3 Barrel Coquina Shell or approved equal.

D. SUBSTITUTIONS: The use of products other than those specified will be considered providing that the Contractor requests its use in writing within 14-days prior to bid date. This request shall be accompanied by the following:
   1. A certificate of compliance from material manufacturer stating that proposed products meet or exceed requirements of this Section, including standards ACI 303.1, ASTM C979, ASTM C494 and AASHTO M194.

2. Documented proof that proposed materials have a 10-year proven record of performance, confirmed by at least 5 local projects that Landscape Architect can examine.

## 2.3 COLORS

A. Concrete Color:
   1. Cement: Color shall be Portland gray.
   2. Sand: Color shall be locally available natural sand.
   3. Aggregate: Concrete producer's standard aggregate complying with specifications.
   4. Colored Admixture: SikaColor – 120G, Color C-20 Limestone. Alternate Color: C12 Mesa Beige. Obtain samples of both.

## 2.4 CONCRETE MIX DESIGN

A. Minimum Cement Content: 5 sacks per cubic yard of concrete.

B. Slump of concrete shall be consistent throughout Project at 4-inches or less. At no time shall slump exceed 5-inches. [If super plasticizers or mid-range water reducers are allowed, slump shall not exceed 8-inches.]

C. Do not add calcium chloride to mix as it causes mottling and surface discoloration.

D. Supplemental admixtures shall not be used unless approved by manufacturer.

E. Do not add water to the mix in the field.

F. Add colored admixture to concrete mix according to manufacturer's written instructions.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

A. Install concrete according to requirements of Division 3 Section "Cast-In-Place Concrete."

B. Do not add water to concrete mix in the field.

C. Surfaces shall be finished uniformly with the following finish:

   1. Smooth Trowel: Precautions should be taken to ensure that the surface is uniformly troweled so that it will not be slippery. Do not over-trowel or burnish the surface.

   2. Exposed #2 / #3 Coquina Shell Finish: After initial Bull-Float hand broadcast #2 / #3 Coquina shells completely covering the concrete surface. Use approximately 1.25 lb to 1.5 lb. of shells per square foot. Bull-Float the shells into the concrete surface until

they are completely covered by cement paste. Let the concrete cure for 5-10 days before exposing shells by light sandblasting. The amount of shell to be exposed shall be determined by a 10' x 10' mock-up panel approved by the Landscape Architect.

## 3.2 CURING & SEALING

A. Integrally Colored Concrete: Apply curing and sealing compound for integrally colored concrete according to manufacturer's instructions using manufacturer's recommended application techniques. Apply curing and sealing compound at consistent time for each pour to maintain close color consistency.

B. Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 *Plastic Shrinkage Cracking* published by the National Ready Mixed Concrete Association.

C. Do not cover concrete with plastic sheeting.

## 3.3 TOLERANCES

A. Minor variations in appearance of integrally colored concrete, which are similar to natural variations in color and appearance of uncolored concrete, are acceptable.

END OF SECTION

# SECTION 042200 - CONCRETE 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 Section, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Miscellaneous masonry accessories.
6. Masonry-cell fill.

### 1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: Contractor is responsible for engage and pay for testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties.

b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Integral water repellant used in CMUs.

3. Cementitious materials. Include name of manufacturer, brand name, and type.

4. Mortar admixtures.

5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

6. Grout mixes. Include description of type and proportions of ingredients.

7. Reinforcing bars.

8. Joint reinforcement.

9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109 for compressive strength, ASTM C1506 for water retention, and ASTM C91 for air content.

2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602/ACI 530.1/ASCE 6.

E. Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.

2. Protect sills, ledges, and projections from mortar droppings.

3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

### 2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602/ACI 530.1/ASCE 6.

### 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.

### 2.4 CONCRETE MASONRY UNITS

A. 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, headers, bonding, and other special conditions.

2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900psi.

2. Density Classification: Normal weight unless otherwise indicated.

3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

4. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

## 2.5 CONCRETE AND LINTELS

A. General: Provide one of the following:

B. Precast or Formed-in-Place Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 032000 "Concrete Reinforcing," and with reinforcing bars indicated.

## 2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content is not more than 0.1 percent when tested in accordance with ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91.

E. Mortar Cement: ASTM C1329.

F. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

3. White-Mortar Aggregates: Natural white sand or crushed white stone.

G. Aggregate for Grout: ASTM C404.

H. Water: Potable.

## 2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A615 or ASTM A996, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951.

1. Interior Walls: Hot-dip galvanized carbon steel.

2. Exterior Walls: Hot-dip galvanized carbon steel.

3. Wire Size for Side Rods: 0.148-inch diameter.

4. Wire Size for Cross Rods: 0.148-inch diameter.

5. Spacing of Cross Rods: Not more than 16 inch 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 extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82, with ASTM A153, Class B-2 coating.

2. Steel Sheet, Galvanized after Fabrication: ASTM A1008, Commercial Steel, with ASTM A153, Class B coating.

## 2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

2. Use portland cement-lime mortar unless otherwise indicated.

3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion and Property Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For reinforced masonry, use Type M or Type S.

D. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C476, for specified 28-day compressive strength indicated, but not less than 3000 psi.

3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

2. Verify that foundations are within tolerances specified.

3. Verify that reinforcing dowels are properly placed.

4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

### 3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch minus 1/4 inch.

2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.

3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.

3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.

5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.

7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.

2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

## 3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Do not embed items in cores of hollow masonry units.

F. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

G. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

## 3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.

2. Bed webs in mortar in all courses of piers, columns, and pilasters.

3. Bed webs in mortar in grouted masonry, including starting course on footings.

4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

## 3.6 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.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

## 3.7 LINTELS

A. Provide concrete lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

## 3.8 REINFORCED UNIT MASONRY

A. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

B. 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, unless otherwise approved by Engineer on record in writing.

## 3.9 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 is done at Contractor's expense.

B. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

C. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140 for compressive strength.

D. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

E. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for compressive strength.

F. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.

**3.10 REPAIRING, POINTING, AND CLEANING**

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

**3.11 MASONRY WASTE DISPOSAL**

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

**END OF SECTION 04 22 00**

**SECTION 044313**

**STONE MASONRY VENEER**

## PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Samples for stone and colored mortar.

B. Submit qualification data for masonry contractor, including a list of completed projects.

C. Construct a sample wall panel approximately 48 inches (1200 mm) long by 48 inches (1200 mm) high to demonstrate aesthetic effects and set quality standards for materials and execution.

D. Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

2.1 STONE

A. Limestone: ASTM C 568, Classification II Medium-Density.

B. Varieties and Sources:

1. Oolite coral stone – Oolite veneer - Epic Stoneworks

C. Match Architect's samples for stone characteristics relating to aesthetic effects.

2.2 MORTAR

A. Mortar for Stone Masonry Veneer: ASTM C 270, Proportion Specification, Type S for setting stone, Type N for pointing.

1. Use portland cement-lime mortar.
2. Low-Alkali Cement: Use portland cement with not more than 0.60 percent total alkali per ASTM C 114.
3. Colored Pointing Mortar: Use colored cement product of color selected.

B. Latex-Modified Portland Cement Setting Mortar: Proportion and mix portland cement, aggregate, and latex additive to comply with latex-additive manufacturer's written instructions.

1. Latex Additive: Manufacturer's standard water emulsion.

a. Manufacturers: One of the following:
1) Bostik, Inc.
2) Laticrete International, Inc.

3) MAPEI Corporation.
4) Southern Grouts & Mortars, Inc.
5) Summitville Tiles, Inc.
6) TEC Specialty Construction Brands, Inc.; an H. B. Fuller company.

C. Mortar for Scratch Coat over Metal Lath: 1 part portland cement, 1/2 part lime, and 5 parts sand.

D. Mortar for Scratch Coat over Unit Masonry: 1 part portland cement, 1 part lime, and 7 parts sand.

2.3 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Stainless steel, 0.016 inch thick or 0.0135 inch thick for fully concealed flashing.

2.4 MISCELLANEOUS MATERIALS

A. Dampproofing for Limestone: Cementitious dampproofing recommended by ILI.

B. Weeps: Round polyethylene tubing, 3/8".

C. Expanded Metal Lath: ASTM C 847, 3.4-lb/sq. yd., galvanized, self-furring, diamond-mesh lath.

D. Welded-Wire Lath: ASTM C 933, 2-by-2-inchmesh, 0.0625-inch-diameter, galvanized-steel wire.

E. Acidic Cleaner: Cleaner designed for removing mortar stains from stone masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

1. Manufacturers: One of the following:

a. Diedrich Technologies, Inc.
b. Dominion Restoration Products.
c. EaCo Chem, Inc.
d. Hydrochemical Techniques, Inc.
e. Prosoco, Inc.

2.5 STONE FABRICATION

A. Gage backs of stones more than 81 sq. in. in area.

B. Thickness of Stone Masonry Veneer: 1-1/2"

C. Type of Masonry (Pattern): Sawed-bed, broken-range ashlar with random course heights and random lengths (interrupted coursed)

D. Finish:
1. Oolite venner

**PART 3 - EXECUTION**

3.1 SETTING STONE MASONRY VENEER, GENERAL

A. Accurately mark stud centerlines on face of weather-resistant sheathing paper before beginning stone installation.

B. Execute stone masonry by skilled masons experienced with the kind and form of stone and installation method indicated. Arrange stones for good fit, in pattern indicated.

C. Maintain uniform joint widths except for variations due to different stone sizes and minor variations required to maintain bond alignment. Lay walls with joints not less than 1/4 inch at narrowest points or more than 3/8 inch at widest points.

D. Install embedded flashing and weeps at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Extend flashing 4 inches into masonry at each end and turn up 2 inches to form a pan.

E. Coat limestone with dampproofing on beds, joints, and back surfaces to at least 12 inches above finish-grade elevations, and on face surfaces up to finish-grade elevations.

3.2 INSTALLING ADHERED STONE MASONRY VENEER

A. Install lath over weather-resistant sheathing paper by fastening through sheathing into framing to comply with ASTM C 1063.

B. Install lath over unit masonry and concrete to comply with ASTM C 1063.

C. Install 3/8-inch- thick scratch coat over metal lath. Coat backs of stone units and face of scratch coat with cement-paste bond coat, then butter both surfaces with setting mortar. Tap units into place, completely filling space between units and scratch coat.

D. Rake out joints for pointing 1/2 inch deep.

3.3 POINTING

A. Point stone joints by placing and compacting pointing mortar in layers not more than 3/8 inch (10 mm) deep. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.

B. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce joint profile indicated.

3.4 CLEANING

A. In-Progress Cleaning: Clean masonry as work progresses. Remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly cured, remove large mortar particles, scrub, and rinse stone masonry veneer.

1. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.

**END OF SECTION 044313**

# 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 Section, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Prefabricated building columns.
4. Headed stud connectors.

B. Related Requirements:

1. Section 099113 "Exterior Painting" and Section 099123 "Interior 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.

### 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 Project site.

### 1.6 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.

2. High-strength, bolt-nut-washer assemblies.

3. Headed stud connectors.

4. Anchor rods.

5. Threaded rods.

6. Prefabricated building columns.

7. Galvanized-steel primer.

8. Galvanized repair paint.

9. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, 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.

**1.7 INFORMATIONAL SUBMITTALS.**

A. Qualification Data: For Installer, fabricator, and shop-painting applicators.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.

2. Headed stud connectors.

F. Survey of existing conditions.

## 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,

C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1.

## 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, 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.

B. Connection Design Information:

1. Option 1: Connection designs have been completed and connections indicated on the Drawings.

## 2.2 STRUCTURAL-STEEL MATERIALS

A. Channels, Angles: ASTM A36.

B. Plate and Bar: ASTM A36.

C. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B.

D. Steel Pipe: ASTM A53, Grade B.

E. Welding Electrodes: Comply with AWS requirements.

## 2.3 BOLTS AND CONNECTORS

A. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, Class 10S, heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating

B. Headed Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

## 2.4 RODS

A. Headed Anchor Rods: ASTM F1554, Grade 36.

1. Nuts: ASTM A563 heavy-hex carbon steel.

2. Plate Washers: ASTM A36 carbon steel.

3. Washers: ASTM F436, Type 1, hardened carbon steel.

4. Finish: Hot-dip zinc coating, ASTM A153, Class C.

B. Threaded Rods: ASTM A36.

1. Nuts: ASTM A63 heavy-hex carbon steel.

2. Washers: ASTM F436, Type 1, hardened ASTM A36 carbon steel.

3. Finish: Hot-dip zinc coating, ASTM A153, Class C.

## 2.5 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Galvanized-Steel Primer: [MPI#26] [MPI#80,]

1. Etching Cleaner: MPI#25, for galvanized steel.

2. Galvanizing Repair Paint: ASTM A780**.**

## 2.6 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, 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 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.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Headed 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 and manufacturer's written instructions.

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 and AWS D1.8 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.

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 members indicated in drawings.

## 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.

B. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

C. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.11 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. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:

   a. Liquid Penetrant Inspection: ASTM E165.

   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.

3. In addition to visual inspection, test and inspect shop-welded headed stud connectors in accordance with requirements in AWS D1.1 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.

4. 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.

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.

### 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.

E. Splice members only where indicated.

F. 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.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 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.

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.

C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

**3.6 FIELD QUALITY CONTROL**

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.

2. Verify weld materials and inspect welds.

3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.

**END OF SECTION 05 12 00**

# SECTION 054000 – COLD FORMED 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 Section, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Interior non-load-bearing wall framing.
2. Ceiling joist framing.
3. Soffit framing.

B. Related Requirements:

1. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

### 1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Ceiling joist framing.
3. Interior non-load-bearing wall framing.
4. Soffit framing.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated Design Submittal: For cold-formed steel framing.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Research Reports:

1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

### 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. 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.

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect and store cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling as required in AISI S202.

## PART 2 - PRODUCTS

### 2.1 COLD-FORMED STEEL FRAMING MATERIALS

A. Framing Members, General: Comply with **ASTM C955**; **AISI S200 and ASTM C955, Section 8**; **AISI S240** for conditions indicated.

1. Grade: As indicated in drawings.

2. Coating: G60 or equivalent.

### 2.2 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.

2. Flange-width sequence in "Flange Width" Subparagraph below corresponds to common flange-width designators 137, 162, 200, and 250. Flange widths may vary with application. If sheathing or masonry ties are required, consider minimum flange width of 1-5/8 inches (41 mm).

3. Flange Width: 2 inches.

4. Retain "Section Properties" Subparagraph below if not delegating design responsibility to Contractor. If retaining, indicate whether design is based on gross or effective section properties.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch Matching steel studs

2. Flange Width: 1-1/4 inches <Insert dimension if manufacturer's standard width is insufficient>..

C. Vertical Deflection Clips, Interior: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.

2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: 0.0329 inch.

b. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0428 inch.

b. Flange Width: Insert dimension equal to sum of outer deflection track flange width plus 1 inch.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

## 2.3 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched**,** stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.

2. Flange-width sequence in "Flange Width" Subparagraph below corresponds to common flange-width designators 162, 200, and 250. Flange widths may vary with application.

3. Flange Width: 2 inches.

## 2.4 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch.

2. Flange-width sequence in "Flange Width" Subparagraph below corresponds to common flange-width designators 162, 200, and 250. Flange widths may vary with application.

3. Flange Width: 2 inches, minimum.

## 2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.

2. Bracing, bridging, and solid blocking.

3. Web stiffeners.

4. Anchor clips.

5. End clips.

6. Gusset plates.

7. Stud kickers and knee braces.

8. Hole-reinforcing plates.

9. Backer plates.

## 2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.

B. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

C. Welding Electrodes: Comply with AWS standards.

## 2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780, MIL-P-21035B.

## 2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.

2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

a. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing 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. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

D. Install sill sealer gasket/termite barrier in accordance with manufacturer's written instructions at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

**3.4 INSTALLATION OF INTERIOR NONLOADBEARING WALL FRAMING**

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 12 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.

2. Install double deep-leg deflection tracks and anchor outer track to building structure.

3. Connect vertical deflection clips to studs and anchor to building structure.

4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at 96-inch.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

## 3.5 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error are not to exceed minimum fastening requirements of sheathing or other finishing materials.

## 3.6 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

## 3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.8 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

**END OF SECTION 05 40 00**

**SECTION 064100**

**ARCHITECTURAL WOOD CASEWORK**

## PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Shop Drawings, Samples showing the full range of colors available for each type of finish and AWI Quality Certification Program certificates.

B. Fabricator Qualifications: Certified participant in AWI's Quality Certification Program

C. Installer Qualifications: Fabricator of products.

D. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is completed, and HVAC system is operating.

## PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINETS

A. Quality Standard: AWI, AWMAC, and WI's "Architectural Woodwork Standards."

B. Plastic-Laminate Cabinets: Premium grade.

1. Type of Construction: Frameless.
2. Cabinet and Door and Drawer Front Interface Style: Flush overlay.
3. Laminate Cladding: Horizontal surfaces other than tops, Grade HGS; postformed surfaces, Grade HGP; vertical surfaces, Grade HGS; edges, Grade HGS; semiexposed surfaces, Grade VGS.
4. Drawer Sides and Backs: Solid hardwood.
5. Drawer Bottoms: Hardwood plywood.

2.2 MATERIALS

A. Wood Moisture Content: 5 to 10 percent.

B. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1

C. High-Pressure Decorative Laminate: NEMA LD 3.

1. Manufacturers: One of the following:
   a. Formica Corporation.
   b. Wilsonart International; Div. of Premark International, Inc.

2.3 CABINET HARDWARE AND ACCESSORY MATERIALS

A. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch- thick metal, and as follows:

1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.

C. Wire Pulls: Back mounted, solid metal, 4 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.

D. Catches: Magnetic catches, BHMA A156.9.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests.

F. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

G. Drawer Slides: BHMA A156.9, B05091.

1. Box Drawer Slides: Grade 1HD-100.
2. File Drawer Slides: Grade 1HD-200.
3. Trash Bin Slides: Grade 1HD-200.

H. Drawer Locks: BHMA A156.11, E07041.

I. Exposed Hardware Finishes: Comply with BHMA A156.18 for BHMA code number indicated.

1. Finish: Satin Stainless Steel: BHMA 630.

J. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated Softwood or hardwood lumber, kiln dried to 15 percent moisture content.

2.4 FABRICATION

A. Complete fabrication 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.

2.5 SHOP FINISHING OF WOOD CABINETS

A. Finishes: Same grades as items to be finished.

B. Finish cabinets at the fabrication shop; defer only final touch up until after installation.

1. Apply one coat of sealer or primer to concealed surfaces of cabinets. Apply two coats to end-grain surfaces.

2. Apply a wash coat sealer to woodwork made from closed-grain wood before staining and finishing.
3. After staining, if any, apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.

C. Transparent Finish:
1. Finish: System - 11, catalyzed polyurethane.
2. Sheen: Satin.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Install cabinets to comply with referenced quality standard for grade specified.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Fasten with countersunk concealed fasteners and blind nailing. Use fine finishing nails[ or finishing screws] for exposed nailing, countersunk and filled flush.

F. Cabinets: Install so doors and drawers are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.

1. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

**END OF SECTION 064100**

SECTIONS 075400 – THERMOPLASTIC SINGLE PLY ROOFING

**PART 1 - GENERAL**

1.01 SUMMARY

A. Section Includes
1. Thermoplastic Polyolefin Single-Ply Roofing Membrane
2. Thermoplastic Polyolefin Flashings
3. Thermoplastic Polyolefin Accessories
4. Insulation

B. Related Sections
1. Section 07620: Sheet Metal Flashing and Trim
2. Section 15430: Plumbing Specialties

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM) - *Annual Book of ASTM Standards*
1. ASTM D-751 – Standard Test Methods for Coated Fabrics
2. ASTM D-2137 - Standard Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics
3. ASTM E-96 - Standard Test Methods for Water Vapor Transmission of Materials
4. ASTM D1204 - Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
5. ASTM D-471 - Standard Test Method for Rubber Property—Effect of Liquids
6. ASTM D-1149 - Standard Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment
7. ASTM C-1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer
8. ASTM C-1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers
9. ASTM G155 - Standard Practice For Operating Xenon Arc Light Apparatus For Exposure Of Non-Metallic Materials
10. ASTM D573 - Standard Test Method For Rubber - Deterioration In An Air Oven

B. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - *Architectural Sheet Metal Manual*

C. National Roofing Contractors Association (NRCA)

D. American Society of Civil Engineers (ASCE)

E. U.S. Green Building Council (USGBC)
1. Leadership in Energy and Environmental Design (LEED)

F. Factory Mutual (FM Global) - *Approval Guide*

G. Underwriters Laboratories (UL) - *Roofing Systems and Materials Guide* (TGFU R1306)

H. California Title 24 Energy Efficient Standards

I. ENERGY STAR
J. Cool Roofing Rating Council (CRRC)

K. Miami-Dade County

1.03 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) *Roofing and Waterproofing Manual* for definitions of roofing terms related to this section.

1.04 SUBMITTALS

A. Product Data: Provide product data sheets for each type of product indicated in this section.

B. Shop Drawings: Provide manufacturers standard details and approved shop drawings for the roof system specified.
C. Samples: Provide samples of insulations, fasteners, membrane materials and accessories for verification of quality.

D. Certificates: Installer shall provide written documentation from the manufacturer of their authorization to install the roof system, and eligibility to obtain the warranty specified in this section.

1.05 QUALITY ASSURANCE

A. Manufacturer's Qualifications: GAF shall provide a roofing system that meets or exceeds all criteria listed in this section.

B. Installer's Qualifications
1. Installer shall be classified as a Master or Master Select™ contractor as defined and certified by GAF.

C. Source Limitations: All components listed in this section shall be provided by a single manufacturer or approved by the primary roofing manufacturer.

D. Final Inspection
Manufacturer's representative shall provide a comprehensive final inspection after completion of the roof system. All application errors must be addressed and final punch list completed.

1.06 PRE-INSTALLATION CONFERENCE

A. Prior to scheduled commencement of the roofing installation and associated work, conduct a meeting at the project site with the installer, architect, owner, GAF representative and any other persons directly involved with the performance of the work. The installer shall record conference discussions to include decisions and agreements reached (or disagreements), and furnish copies of recorded discussions to each attending party. The main purpose of this meeting is to review foreseeable methods and procedures related to roofing work.

1.07 PERFORMANCE REQUIREMENTS

A. Provide an installed roofing membrane and base flashing system that does not permit the passage of water, and will withstand the design pressures calculated in accordance with the most current revision of ASCE 7.

B. GAF shall provide all primary roofing materials that are physically and chemically compatible when installed in accordance with manufacturers current application requirements.

1.08 REGULATORY REQUIREMENTS

A. All work shall be performed in a safe, professional manner, conforming to all federal, state and local codes.

1.09 DELIVERY, STORAGE AND HANDLING

A. Deliver all roofing materials to the site in original containers, with factory seals intact. All products are to carry a GAF® label.

B. Store all pail goods in their original undamaged containers in a clean, dry location within their specified temperature range.

C. Do not expose materials to moisture in any form before, during, or after delivery to the site. Reject delivery of materials that show evidence of contact with moisture.

D. Remove manufacturer supplied plastic covers from materials provided with such. Use “breathable” type covers such as canvas tarpaulins to allow venting and protection from weather and moisture. Cover and protect materials at the end of each work day. Do not remove any protective tarpaulins until immediately before the material will be installed.

E. Materials shall be stored above 55°F (12.6°C) a minimum of 24 hours prior to application.

1.10 PROJECT CONDITIONS

A. Weather
1. Proceed with roofing only when existing and forecasted weather conditions permit.
2. Ambient temperatures must be above 45°F (7.2°C) when applying hot asphalt or water based adhesives.

1.11 WARRANTY

A. Provide Manufacturers standard EverGuard® Diamond Pledge™ Guarantee with single source coverage and no monetary limitation where the manufacturer agrees to repair or replace components in the roofing system, which cause a leak due to a failure in materials or workmanship.
1. Duration: Up to Twenty (20) years from the date of completion.

*Materials and workmanship of listed products within this section when installed in accordance with current GAF application and specification requirements. Contact GAF Contractor Services for the full terms and conditions of the guarantee.

**PART 2 - PRODUCTS**

1.12 ACCEPTABLE MANUFACTURER

A. GAF® - 1 Campus Drive, Parsippany, NJ 07054

1.13 INSULATION

A. Rigid polyisocyanurate board, with a glass-reinforced cellulosic felt facer. Conforms to or exceeds the requirements of ASTM C 1289 Type II, Class 1, Grade 2. **EnergyGuard™ Polyiso Insulation**, with the following characteristics:
   1. Board Thickness: 5.2
   2. Thermal Resistance (LTTR value) of: R-30
   3. Compressive Strength: 20 psi

B. Rigid polyisocyanurate board, with a glass-reinforced cellulosic felt facer. Conforms to or exceeds the requirements of ASTM C 1289 Type II, Class 1, Grade 2. **EnergyGuard™ Polyiso Insulation**, with the following characteristics:
   1. Board Thickness: 2.6
   2. Thermal Resistance (LTTR value) of: R-15
   3. Compressive Strength: 20 psi

C. Overlayment board with a water-resistant and silicone treated gypsum core with glass fiber facers embedded on both sides, and pre-primed on one side. GP Dens-Deck Prime Roof Board, distributed by GAF®.
   1. Board Thickness: 1/2"
   2. Thermal Resistance (R value) of: .56

1.14 MEMBRANE MATERIALS

A. A smooth type, polyester scrim reinforced thermoplastic polyolefin membrane with a nominal 0.060 inch (60 mil) thickness, for use as a single ply roofing membrane. Meets or exceeds the minimum requirements of ASTM D-6878. UL Listed, FM Approved, Dade County Product Approval, Florida Building Code Approved. White membrane is Energy Star Listed, CRRC Listed and Title 24 Compliant. **EverGuard® TPO 60 mil** thermoplastic single-ply roofing membrane by GAF.
   1. 10’ X 100’, each roll contains 1000 sq. ft. of roofing material weighing 322 lbs. Each half sheet roll contains approximately 500 sq. ft. of roofing material, 5’ X 100’, weighing 162 lbs.

1.15 FLASHING MATERIALS

A. A smooth type, polyester scrim reinforced thermoplastic polyolefin membrane with a nominal 0.060 inch (60 mil) thickness, for use as a single ply roofing membrane. Meets or exceeds the minimum requirements of ASTM D-6878. UL Listed, FM Approved, Dade County Product Approval, Florida Building Code Approved. White membrane is Energy Star Listed, CRRC Listed and Title 24 Compliant. **EverGuard® TPO 60 mil** thermoplastic single-ply roofing membrane by GAF.

1.16 MEMBRANE ADHESIVES, PRIMERS AND SEALANTS

A. Solvent-based Bonding Adhesive: Solvent based rubberized adhesive for use with EverGuard TPO membranes, **EverGuard® 1121 Bonding Adhesive**, by GAF.

B. Solvent based liquid, required to protect field cut edges of EverGuard TPO membranes. Applied directly from a squeeze bottle, **EverGuard® TPO Cut Edge Sealant**, by GAF.

C. Solvent based primer for preparing surfaces to receive butyl based adhesive tapes, **EverGuard® TPO Primer**, by GAF.

D. Solvent based seam cleaner used to clean exposed or contaminated seam prior to heat welding, **EverGuard® TPO Seam Cleaner, by GAF.**

E. Solvent based, trowel grade synthetic elastomeric sealant. Durable and UV resistant suitable for use where caulk is typically used. Available in 10 oz. tubes, **FlexSeal™ Caulk Grade Roof Sealant** by GAF.

F. Commercial grade roofing sealant suitable for sealing the upper lip of exposed termination bars and penetrations and around clamping rings and comes with a 20 yr. ltd warranty against leaks caused by manufacturing defects. Meets the performance criteria of ASTM D412, ASTM D2196, ASTM D1475 and ASTM D1644, **FlexSeal™** Roof Sealant, by GAF.

1.17 MEMBRANE SEALANTS

A. One part butyl based high viscosity sealant suitable for sealing between flashing membrane and substrate surface behind exposed termination bars and for sealing between roofing membrane and drain flange. **EverGuard® Water Block**, by GAF.

B. One-part, moisture-cure, self-leveling sealant designed for use in pitch pans on single ply roof systems. **EverGuard® One-Part Pourable Sealant**.

1.18 INSULATION ADHESIVE

A. Insulation Adhesive: **Oly-Bond 500™** distributed by GAF®.

1.19 ACCESSORIES

A. FLASHING ACCESSORIES

1. A smooth type, unreinforced thermoplastic polyolefin based membrane for use as an alternative flashing/reinforcing material for penetrations and corners. Required whenever preformed vent boots cannot be used. Use white color only, 0.055 inches (55 mils) nominal thickness and sheet size: 24in x 50ft. **EverGuard® TPO Detailing Membrane**, by GAF.

2. An 8 inch (20 cm) wide smooth type, polyester scrim reinforced thermoplastic polyolefin membrane strip for use as a cover strip over coated metal and stripping-in coated metal flanges and general repairs: 0.045 inches (45 mils) nominal thickness with 100 foot length. Use white color only. **EverGuard® TPO Flashing Membrane**, by GAF.

3. Extruded aluminum termination bar with angled lip caulk receiver and lower leg bulb stiffener. Pre-punched slotted holes at 6” on center or 8” on center. ¾” x 10’ with 0.090” cross section, **Drill-Tec™ Termination Bar,** by GAF.

4. A 6 inch (14 cm) wide, smooth type, heat-weldable polyester scrim reinforced thermoplastic polyolefin membrane strip. Designed for use as a cover strip over non-coated metal edges and flanges. Each full roll contains approximately 100 Lineal Ft. of material, 6” X 100’. **EverGuard® TPO Heat-Weld Cover Tape**, by GAF.

5. .045” reinforced TPO membrane with pressure sensitive adhesive, to be installed on horizontal surfaces using plates and fasteners as a base attachment in fully adhered systems. Size 6” x 100’, **EverGuard® RTA (Roof Transition Anchor) Strip™,** by GAF

6. 24 gauge steel with 0.025” thick TPO based film as required for fabrication into metal gravel stop and drip edge profiles, metal base and curb flashings, sealant pans, and scupper

sleeves. Standard sheet size 4’ x 10’, sheet weight 47 lbs. Custom sizes available, **EverGuard® TPO Coated Metal**, by GAF.

B. WALL & CURB ACCESSORIES

1. 55 mil TPO membrane and 24 gauge coated metal prefabricated into standard and custom size thru wall scuppers**.** Available in two sizes: 4" x 6" x 12" (l x w x d) with a 5.75" x 3.75" opening and 8" x 10" x 12" (l x w x d) with a 9.75" x 7.75" opening, **EverGuard® TPO Scupper,** by GAF

2. .045” thick reinforced TPO membrane fabricated corners. Available in four standard sizes to flash curbs. Four corners are required to flash the curb, **EverGuard® Corner Curb Wraps,** by GAF.

3. 0.045” thick molded TPO membrane outside corners of base and curb flashing. Hot-air welds directly to EverGuard TPO membrane. Size 4” x 4” with 6” flange, **EverGuard® TPO Universal Corners** by GAF.

4. 0.055” molded TPO membrane inside corners of base and curb flashing. Hot-air welds directly to EverGuard TPO membrane. Size 6” x 6” x 5.5” high **EverGuard® TPO Preformed Corners** by GAF.

5. 8” diameter, nominal .050” vacuum formed unreinforced TPO membrane for use in flashing outside corners of base and curb flashings, **EverGuard® TPO Fluted Corner**, by GAF.

C. PENETRATION ACCESSORIES

1. 0.075” thick molded TPO membrane sized to accommodate most common pipe and conduits, (1” to 6” diameter pipes), including square tube. Hot-air welded directly to EverGuard TPO membrane, supplied with stainless steel clamping rings, **EverGuard® TPO Preformed Vent Boots** by GAF.

2. 0.045” thick molded TPO membrane preformed boots are split to accommodate most common pipes and conduits and available in three standard sizes, **EverGuard® TPO Split Pipe Boots**, by GAF.

3. 0.045” thick molded TPO membrane preformed square boots are split to accommodate most common square penetrations and conduits and available in three standard sizes, **EverGuard® TPO Square Tube Wraps**, by GAF.

4. .070 thick molded penetration pocket to provide structure and foundation for the application of a pourable sealant for a variety of roof penetrations, weldable and 9" x 6" x 4" (l x w x h). **EverGuard® TPO Pourable Sealer Pocket**

5. Constructed from spun aluminum and preflashed using .055” thick smooth type, unreinforced thermoplastic polyolefin membrane. Available in a wide range of sizes to allow a proper fit into any size roofing drain. **EverGuard® TPO Drain** by GAF

6. Aluminum drain unit coated with a weldable TPO compound. TPO membrane can be heat welded directly to the drain body, resulting in a strong, secure installation. Each drain is fitted with a BlueSeal® mechanical drain seal for a secure, tight seal into the building drain system. Available in two sizes (3” and 4”), and custom sizes are available. **EverGuard® TPO Coated Metal Drain** by GAF®

D. ROOF EDGE ACCESSORIES

1. Coping system with pre-punched holes and snap-on design. Contains a metal clip that functions as a gutter to help channel water back onto the roof. Available for wall sizes 4" to 32" (102 mm – 813 mm). **M-Weld™ Snap-On Coping** (contains 20 gauge clip) or **M-Weld™ Snap-On Coping Plus** (contains 16 gauge clip) by GAF®.

2. Three piece fascia system with continuous galvanized steel spring cant, exterior decorative snap-on fascia and available in 10 foot lengths in standard or custom colors, **EverGuard® Snap-on Fascia** by GAF®.

3. Two piece fascia system with rigid terminator base plate and exterior decorative fascia cover available in 10 foot lengths in standard or custom colors for use with 45 mil and 60 mil only, **EverGuard® EZ Fascia** by GAF®.

4. Two piece fascia system with rigid extruded terminator base plate and exterior decorative snap-on fascia cover available in 10 foot lengths in standard or custom colors, **EverGuard® EZ Fascia EX** by GAF®.

E. FIELD OF ROOF ACCESSORIES

1. Pre-manufactured expansion joint covers used to bridge expansion joint openings in a roof structure. Fabricated to accommodate all roof to wall and roof to roof applications, made of .060" reinforced TPO membrane, available in 5 standard sizes for expansion joint openings up to 8" wide. **EverGuard® TPO Expansion Joint Covers,** by GAF

2. .055" thick smooth type, unreinforced thermoplastic polyolefin membrane designed for use as a conforming membrane seal over T-joints in 60 and 80 mil membrane applications. **EverGuard® T-Joint Patches**, by GAF.

3. 1/8" thick extruded and embossed TPO roll 34" x 50', heat welds directly to roofing membrane. Unique herringbone traction surface. Available in gray or yellow, **EverGuard® TPO Walkway Rolls**, GAF.

**PART 3 - EXECUTION**

1.20 EXAMINATION

A. Verify that the surfaces and site conditions are ready to receive work.

B. Verify that the deck is supported and secured.

C. Verify that the deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains, valleys, eaves, scuppers or gutters.

D. Verify that the deck surfaces are dry and free of ice or snow.

E. Verify that all roof openings or penetrations through the roof are solidly set, and that all flashings are tapered.

1.21 SUBSTRATE PREPARATION

A. Structural Concrete Deck

1. Minimum deck thickness for structural concrete is 4” (10.2 cm).
2. Only poured in place concrete decks that provide bottom side drying are acceptable. Decks that are installed over non-vented metal decks or pans that remain in place may trap moisture in the deck beneath the roof system and are not acceptable.
3. The roof deck shall be properly cured prior to application of the roofing system; twenty-eight (28) days is normally required for proper curing. Curing agents must be checked for compatibility with roofing materials. Prior to the installation of the roof assemblies, GAF recommends the evaluation of the surface moisture and deck’s dryness through the use of ASTM D-4263 or hot bitumen test.
4. The deck must be smooth, level and cannot be wet or frozen. If deck is determined to be wet, it must be allowed to dry.
5. Treat cracks greater than 1/8” (3 mm) in width in accordance with the deck manufacturer’s recommendations.
6. Sumps for the roof drains shall be provided in the casting of the deck.
7. When insulation or roofing is to be adhered with hot asphalt, prime the deck with asphalt/concrete primer, ASTM D 41 at the rate of one gallon per 100 square feet (0.4 L/m2 ). Allow the primer to dry prior to the application of the roofing system.
8. In all retrofit roof applications, it is required that deck be inspected for defects. Any defects are to be corrected per the deck manufacturer’s recommendations prior to the new roof application.
9. Code standards apply when their requirements exceed those listed here.

1.22 INSTALLATION - GENERAL

A. Install GAF’s EverGuard® TPO roofing system according to all current application requirements in addition to those listed in this section.

B. GAF EverGuard® TPO Specification #: TFANI60

C. Start the application of membrane plies at the low point of the roof or at the drains, so that the flow of water is over or parallel to, but never against the laps.

1.23 INSULATION - GENERAL

A. Do not apply roof insulation or roofing until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment. A vapor retarder coated lightly with asphalt may be applied to protect the inside of the structure prior to the insulation and final roofing installation. Before the application of the insulation, any damage or deterioration to the vapor retarder must be repaired.

B. Do not install wet, damaged or warped insulation boards.

C. Install insulation boards with staggered board joints in one direction (unless taping joint).

D. Install insulation boards snug. Gaps between board joints must not exceed ¼” (6 mm). All gaps in excess of ¼” (6 mm) must be filled with like insulation material.

E. Wood nailers must be 3-1/2” (8.9 cm) minimum width or 1” (25 mm) wider than metal flange. They shall be of equal thickness as the insulation, and be treated for rot resistance. All nailers must be securely fastened to the deck.

F. Do not kick insulation boards into place.

G. Miter and fill the edges of the insulation boards at ridges, valleys and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing of the insulation at the corners.

H. Insulation should not be installed over new lightweight insulating concrete.

I. Do not install any more insulation than will be completely waterproofed each day.

1.24 INSULATION – BASE LAYER

A. The substrate must be free of and debris, dust, dirt, oil, grease, and standing water before applying the adhesive.

B. OlyBond 500 must be applied using the specially designed PaceCart dispenser. OlyBond 500 SpotShot shall be applied using one of the specially designed dual cartridge dispensers. OlyBond 500 Equipment Free Canister System dispenses with 25' hose and gun assembly included with product.

C. Install insulation layers applied with bands of OlyBond 500 spaced 12" O.C. Approximate coverage rate is ½ to 1 gallon per 100 square feet, depending on the substrate. Allow the foam to rise ¾" to 1". Walk each board firmly into place. Stagger the joints of additional layers in relation to the insulation joints in the layer(s) below by a minimum of 6" (15.2 cm) to eliminate continuous vertical gaps.

D. Do not install any more insulation than will be completely waterproofed each day.

1.02 INSULATION – SUBSEQUENT LAYERS

A. The substrate must be free of and debris, dust, dirt, oil, grease, and standing water before applying the adhesive.

B. OlyBond 500 must be applied using the specially designed PaceCart dispenser. OlyBond 500 SpotShot shall be applied using one of the specially designed dual cartridge dispensers. OlyBond 500 Equipment Free Canister System dispenses with 25' hose and gun assembly included with product.

C. Install insulation layers applied with bands of OlyBond 500 spaced 12" O.C. Approximate coverage rate is ½ to 1 gallon per 100 square feet, depending on the substrate. Allow the foam to rise ¾" to 1". Walk each board firmly into place. Stagger the joints of additional layers in relation to the insulation joints in the layer(s) below by a minimum of 6" (15.2 cm) to eliminate continuous vertical gaps.

D. Do not install any more insulation than will be completely waterproofed each day.

1.03 MEMBRANE APPLICATION

A. Adhered:
1. Place membrane so that wrinkles and buckles are not formed. Any wrinkles or buckles must be removed from the sheet prior to permanent attachment. Roof membrane shall be fully adhered immediately after it is rolled out, followed by welding to adjacent sheets.
2. Overlap roof membrane a minimum of 3" (15 cm) for side laps and 3" (15 cm) for end laps.
3. Install membrane so that the side laps run across the roof slope lapped towards drainage points.
4. All exposed sheet corners shall be rounded a minimum of 1".

5. Use full width rolls in the field and perimeter region of roof.
6. Use appropriate bonding adhesive for substrate surface, applied with a solvent-resistant roller, brush or squeegee.
7. Apply bonding adhesive at 3 squares of finished, mated surface area per 5 gallons (*Solvent Based*). A greater quantity of bonding adhesive may be required based upon the substrate surface condition.
8. Prevent seam contamination by keeping the adhesive application a few inches back from the seam area.
9. Adhere approximately one half of the membrane sheet at a time. One half of the sheet's length shall be folded back in turn to allow for adhesive application. Lay membrane into adhesive once the bonding adhesive is tacky to the touch.
10. Roll membrane with a weighted roller to ensure complete bonding between adhesive and membrane.
11. Membrane laps shall be heat-welded together. All welds shall be continuous, without voids or partial welds. Welds shall be free of burns and scorch marks.
12. Weld shall be a minimum of 1-1/2" in width for automatic machine welding and a minimum 2" in width for hand welding.
13. All cut edges of reinforced membrane must be sealed with EverGuard® TPO Cut Edge Sealant.
14. Supplemental membrane attachment is required at the base of all walls and curbs, and where the angle of the substrate changes by more than five (5) degrees (1" in 12"). Roofing membrane shall be secured to the structural deck with appropriate Drill-Tec™ screws and plates spaced every 12" o.c. The screws and plates must be installed no less than ½" from the membrane edge. Alternatively, the roofing membrane may be turned up the vertical plane a minimum of 3" and secured with screws and termination bar. Fastener spacing is the same as is used for in-lap attachment. The termination bar must be installed within 1-1/2" to 2" of the plane of the roof membrane, with a minimum of 1" of membrane extending above the termination bar.
15. Supplemental membrane attachment to the structural deck is required at all penetrations unless the insulation substrate is fully adhered to the deck. Roofing membrane shall be secured to the deck with appropriate Drill-Tec™ screws and plates.
16. Fasteners must be installed to achieve the proper embedment depth. Install fasteners without lean or tilt.
17. Install fasteners so that the plate or termination bar is drawn down tightly to the membrane surface. Properly installed fasteners will not allow the plate or termination bar to move (underdriving), but will not cause wrinkling of the membrane (overdriving).

1.04 FLASHINGS

A. General:
1. All penetrations must be at least 24" (61 cm) from curbs, walls, and edges to provide adequate space for proper flashing.
2. Flash all perimeter, curb, and penetration conditions with coated metal, membrane flashing, and flashing accessories as appropriate to the site condition.
3. All coated metal and membrane flashing corners shall be reinforced with preformed corners or non-reinforced membrane.
4. Hot-air weld all flashing membranes, accessories, and coated metal. A minimum 2" wide (hand welder) weld or minimum 1 - 1/2" automatic machine weld is required.
5. All cut edges of reinforced membrane must be sealed with EverGuard® TPO Cut Edge Sealant.
6. Consult the EverGuard® *Application and Specifications Manual* or GAF Contractor Services for more information on specific construction details, or those not addressed in this section.

B. Coated Metal Flashings:

1. Coated metal flashings shall be formed in accordance with current EverGuard construction details and SMACNA guidelines.
2. Coated metal sections used for roof edging, base flashing and coping shall be butted together with a ¼" gap to allow for expansion and contraction. Hot-air weld a 6" wide reinforced membrane flashing strip to both sides of the joint, with approximately 1" on either side of the joint left un-welded to allow for expansion and contraction. 2" wide aluminum tape can be installed over the joint as a bond-breaker, to prevent welding in this area.
3. Coated metal used for sealant pans, scupper inserts, corners of roof edging, base flashing and coping shall be overlapped or provided with separate metal pieces to create a continuous flange condition, and pop-riveted securely. Hot-air weld a 6" wide reinforced membrane flashing strip over all seams that will not be sealed during subsequent flashing installation.
4. Provide a ½" hem for all exposed metal edges to provide corrosion protection and edge reinforcement for improved durability.
5. Provide a ½" hem for all metal flange edges whenever possible to prevent wearing of the roofing and flashing membranes at the flange edge.
6. Coated metal flashings shall be nailed to treated wood nailers or otherwise mechanically attached to the roof deck, wall or curb substrates, in accordance with construction detail requirements.

C. Reinforced Membrane Flashings:
1. The thickness of the flashing membrane shall be the same as the thickness of the roofing membrane.
2. Membrane flashing may either be installed loose or fully adhered to the substrate surface in accordance with "Construction Detail Requirements".
3. Where flashings are to be fully adhered, apply bonding adhesive at a rate resulting in 60 square feet/gallon of finished roofing material for solvent-based bonding adhesives, and at a rate of 125 square feet/gallon of finished roofing material for water-borne bonding adhesive. Apply bonding adhesive to both the underside of the membrane and the substrate surface at 120 square feet per gallon (Solvent Based) and 250 square feet per gallon (Water Based). A greater quantity of bonding adhesive may be required based upon the substrate surface condition. The bonding adhesive must be allowed to dry until tacky to the touch before flashing membrane application.
4. Apply the adhesive only when outside temperature is above 40°F. Recommended minimum application temperature is 50°F to allow for easier adhesive application.
5. The membrane flashing shall be carefully positioned prior to application to avoid wrinkles and buckles.

D. Un-reinforced Membrane Flashings:
1. Un-reinforced membrane is used to field-fabricate penetration or reinforcement flashings in locations where preformed corners and pipe boots cannot be properly installed.
2. Penetration flashings constructed of un-reinforced membrane are typically installed in two sections, a horizontal piece that extends onto the roofing membrane and a vertical piece that extends up the penetration. The two pieces are overlapped and hot-air welded together.
3. The un-reinforced membrane flashing shall be adhered to the penetration surface. Apply bonding adhesive at a rate resulting in 60 square feet/gallon of finished roofing material for solvent-based bonding adhesives, and at a rate of 125 square feet/gallon of finished roofing material for water-borne bonding adhesive. Apply bonding adhesive to both the underside of the membrane and the substrate surface at 120 square feet per gallon (Solvent Based) and 250 square feet per gallon (Water Based). A greater quantity of bonding adhesive may be required based upon the substrate surface condition. The bonding adhesive must be allowed to dry until tacky to the touch before flashing membrane application.

E. Roof Edges:

1. Roof edge flashings are applicable for gravel stop and drip edge conditions as well as for exterior edges of parapet walls.
2. Flash roof edges with metal flanges nailed 4" O.C. to pressure-treated wood nailers. Where required, hot-air weld roof membrane to coated metal flanges.
3. When the fascia width exceeds 4", coated metal roof edging must be attached with a continuous cleat to secure the lower fascia edge. The cleat must be secured to the building no less than 12" O.C.
4. Alternatively, roof edges may be flashed with a 2-piece snap on fascia system, adhering the roof membrane to a metal cant and face nailing the membrane 8" on center prior to installing a snap-on fascia.
5. Flash roof edge scuppers with a coated metal insert that is mechanically attached to the roof edge and integrated as a part of the metal edging.

F. Parapet and Building Walls:
1. Flash walls with EverGuard TPO membrane adhered to the substrate with bonding adhesive, loose applied (Less than 24" in height) or with coated metal flashing nailed 4" on center to pressure-treated wood nailers.
2. Secure membrane flashing at the top edge with a termination bar. Water Block shall be applied between the wall surface and membrane flashing underneath all exposed termination bars. Exposed termination bars shall be mechanically fastened 8" on center; termination bars that are counter flashed shall be fastened 12" on center.
3. Roof membrane must be mechanically attached along the base of walls with screws and plates (deck securement) or screws and inverted termination bar (wall securement) at the following rate:

| | |
|---|---|
| Adhered systems | 12" on center |

4. All coated metal wall flashings and loose applied membrane flashings must be provided with separate metal counterflashing, or metal copings.
5. Metal counterflashing may be optional with fully adhered flashings depending on guarantee requirements. Exposed termination bars must be sealed with FlexSeal® roofing cement or FlexSeal® caulk grade.
6. Flash wall scuppers with a coated metal insert that is mechanically attached to the wall and integrated as part of the wall flashing.

G. Curbs and Ducts:
1. Flash curbs and ducts with EverGuard TPO membrane adhered to the curb substrate with bonding adhesive, loose applied (Less than 18" in height) or with coated metal flashing nailed 4" on center to pressure-treated wood nailers.
2. Secure membrane flashing at the top edge with a termination bar. Water Block shall be applied between the curb/duct surface and membrane flashing underneath all termination bars. Exposed termination bars shall be mechanically fastened every 8"o.c.; termination bars that are counter flashed shall be fastened 12" on center.
3. Roof membrane must be mechanically attached along the base of walls with screws and plates (deck securement) or screws and inverted termination bar (wall securement) at the following rate:

| | |
|---|---|
| Adhered Systems | 12" on center |

4. All coated metal curb flashings and loose applied membrane flashings must be provided with separate metal counterflashing, or metal copings.
5. Metal counterflashing may be optional with fully adhered flashings depending on guarantee requirements. Exposed termination bars must be sealed with FlexSeal® roofing cement or FlexSeal® caulk grade.

H. Roof Drains:
1. Roof drains must be fitted with compression type clamping rings and strainer baskets. Original-type cast iron and aluminum drains, as well as retrofit-type cast iron, aluminum or molded plastic drains are acceptable.
2. Roof drains must be provided with a minimum 36” x 36” sump. Slope of tapered insulation within the sump shall not exceed 4” in 12”.
3. Extend the roofing membrane over the drain opening. Locate the drain and cut a hole in the roofing membrane directly over the drain opening. Provide a ½” of membrane flap extending past the drain flange into the drain opening. Punch holes through the roofing membrane at drain bolt locations.
4. For cast iron and aluminum drains, the roofing membrane must be set in a full bed of water block on the drain flange prior to securement with the compression clamping ring. Typical water block application is one 10.5 ounce cartridge per drain.
5. Lap seams shall not be located within the sump area. Where lap seams will be located within the sump area, a separate roof membrane drain flashing a minimum of 12” larger than the sump area must be installed. The roof membrane shall be mechanically attached 12” on center around the drain with screws and plates. The separate roof drain flashing shall be heat welded to the roof membrane beyond the screws and plates, extended over the drain flange, and secured as above.
6. Tighten the drain compression ring in place.

1.05 TRAFFIC PROTECTION

A. Install walkway rolls at all roof access locations and other designated locations including roof-mounted equipment work locations and areas of repeated rooftop traffic.

B. Walkway pads must be spaced 2" apart to allow for drainage between the pads.

C. Heat-weld walkway rolls to the roof membrane surface continuously around the perimeter of the roll.

D. Walkway rolls may be installed with TPO primer and 3” seam tape.
1. Roll or brush the TPO primer on the back of the TPO pad along the edges and down the middle length of the pad.
2. Clean and prime the roof membrane where the pad will be installed.
3. Install tape to the back of the cleaned area of the pad and roll in with a silicone hand roller.
4. Remove release paper and install the tapes pads directly onto the roof membrane. Roll pads to secure in place

1.06 ROOF PROTECTION

A. Protect all partially and fully completed roofing work from other trades until completion.

B. Whenever possible, stage materials in such a manner that foot traffic is minimized over completed roof areas.

C. When it is not possible to stage materials away from locations where partial or complete installation has taken place, temporary walkways and platforms shall be installed in order to protect all completed roof areas from traffic and point loading during the application process.

D. Temporary tie-ins shall be installed at the end of each workday and removed prior to commencement of work the following day.

1.07 CLEAN-UP

A. All work areas are to be kept clean, clear and free of debris at all times.

B. Do not allow trash, waste, or debris to collect on the roof. These items shall be removed from the roof on a daily basis.

C. All tools and unused materials must be collected at the end of each workday and stored properly off of the finished roof surface and protected from exposure to the elements.

D. Dispose of or recycle all trash and excess material in a manner conforming to current EPA regulations and local laws.

E. Properly clean the finished roof surface after completion, and make sure the drains and gutters are not clogged.

F. Clean and restore all damaged surfaces to their original condition.

**END OF SECTION 075400**

# SECTION 083323 - OVERHEAD COILING DOORS

## PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Shop Drawings.

## PART 2 - PRODUCTS

2.1 OVERHEAD COILING DOORS

A. Manufacturers:
1. Best Rolling Manufacturer
2. Cookson Company.

B. Fire-Rated Doors: 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. 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.

C. Door Curtain Slats: A60 w/ factory applied finish Color TBD – Kynar 70%

D. Operation: **Electrical**.

E. Obstruction Detection Device: Equip motorized door with external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

F. Tracks, Supports, and Hardware: Manufacturer's standard.

G. Weatherseals: Provide replaceable weather stripping at bottom and at top of exterior doors.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install door, track, and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports.

B. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

C. Install fire-rated doors to comply with NFPA 80.

D. Test and adjust controls and safeties.

**END OF SECTION 083323**

## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data, Shop Drawings, and color Samples.

1. For entrance doors, include hardware schedule.

### PART 2 – PRODUCTS

1.2 ALUMINUM-FRAMED STOREFRONTS

A. Manufacturers: To be selected

B. Basis-of-Design Product: Product indicated on Drawings

C. Accessible Entrances: Comply with ICC A117.1.

D. Performance Requirements:

1. Limit deflection of framing members normal to wall plane to 1/175 of clear span for spans 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 greater than 13 feet 6 inches (4.1 m)] or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Limit deflection of framing members parallel to glazing plane to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
3. Structural Testing: Systems tested according to ASTM E 330 at percent of inward and outward wind-load design pressures do not evidence material failures, structural distress, deflection failures, or permanent deformation of main framing members exceeding 0.2 percent of clear span.
4. Air Infiltration: Limited to 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of system surface area when tested according to ASTM E 283 at a static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa).
5. Water Penetration: Systems do not evidence water leakage when tested according to ASTM E 331 at minimum differential pressure of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
6. Thermal Conductance: Average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K when tested according to AAMA 1503.
7. Windborne-Debris Resistance: Framing system and doors pass basic -protection testing requirements in ASTM E 1996 for Wind Zone 4 when tested according to ASTM E 1886.

E. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated; ASTM B 209 (ASTM B 209M) sheet; ASTM B 221 (ASTM B 221M) extrusions.

F. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

G. Doors: 1-3/4-inch- (44.5-mm-) thick glazed doors with minimum 0.125-inch- (3.2-mm-) 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 snap-on extruded-aluminum glazing stops, and preformed gaskets.

1. Door Design: As indicated.
2. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
3. Interior Doors: Provide BHMA A156.16 silencers, three on strike jamb of single-door frames and two on head of double-door frames.
4. Exterior Doors: Provide compression weather stripping at fixed stops. At other locations, provide sliding weather stripping retained in adjustable strip mortised into door edge.
5. Hardware: As specified in Section 087100 "Door Hardware."

H. Fasteners and Accessories: Compatible with adjacent materials, corrosion resistant, nonstaining, and nonbleeding. Use concealed fasteners except for application of door hardware.

I. Fabrication: Fabricate framing in profiles indicated for flush glazing (without projecting stops). Provide subframes and reinforcing of types indicated or, if not indicated, as required for a complete system. Factory assemble components to greatest extent possible. Disassemble components only as necessary for shipment and installation.

1. Door Framing: Reinforce to support imposed loads. Factory assemble door and frame units and factory install hardware to greatest extent possible. Reinforce door and frame units for hardware indicated. Cut, drill, and tap for factory-installed hardware before finishing components.

J. Aluminum Finish: Class II, clear anodic finish; complying with AAMA 611.

**PART 3 - EXECUTION**

1.3 INSTALLATION

A. Isolate metal surfaces in contact with incompatible materials, including wood, by painting contact surfaces with bituminous coating or primer, or by applying sealant or tape recommended by manufacturer.

B. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install framing components true in alignment with established lines and grades to the following tolerances:

1. Variation from Plane: Limit to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment: For surfaces abutting in line, limit offset to 1/16 inch (1.5 mm). For surfaces meeting at corners, limit offset to 1/32 inch (0.8 mm).
3. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

E. Install doors without warp or rack. Adjust doors and hardware to provide tight fit at contact points and smooth operation.

**END OF SECTION 084113**

## SECTION 087100 - DOOR HARDWARE

### PART 1 - GENERAL

1. SECTION REQUIREMENTS

   a. Allowances: Door hardware is included in Hardware Allowance.

   b. Submittals: Hardware schedule and keying schedule.

### PART 2 - PRODUCTS

2. HARDWARE

   a. Fire-Resistance-Rated Assemblies: Provide products that comply with NFPA 80 and are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for applications indicated. On exit devices provide label indicating "Fire Exit Hardware."

   b. All 316 stainless steel components

   c. Hinges:

      1) Stainless-steel hinges with stainless-steel pins for exterior.
      2) Nonremovable hinge pins for exterior and public interior exposure.
      3) Ball-bearing hinges for doors with closers and entry doors.
      4) Three hinges for 1-3/4-inch- (45-mm-) thick doors 90 inches (2300 mm) or less in height; four hinges for doors more than 90 inches (2300 mm) in height.

   d. Locksets and Latchsets:

      1) Manufacturers: One of the following:
         a) Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
         b) Medeco Security Locks, Inc.; an ASSA ABLOY Group company.
         c) SARGENT Manufacturing Company; an ASSA ABLOY Group company.
         d) Schlage Commercial Lock Division; an Ingersoll-Rand company.
         e) Yale Security Inc.; an ASSA ABLOY Group company.

      2) BHMA A156.2, Series 4000, Grade 1 for bored locks and latches.
      3) BHMA A156.3, Grade 1 for exit devices.
      4) BHMA A156.5, Grade 1 for auxiliary locks.
      5) BHMA A156.12, Series 5000, Grade 1 for interconnected locks and latches.
      6) BHMA A156.13, Series 1000, Grade 1 for mortise locks and latches.
      7) Lever handles on locksets and latchsets,
      8) Provide trim on exit devices matching locksets.

   e. Key locks to Owner's master-key system.

1) Cylinders with six-pin tumblers.
2) Provide cylinders for overhead doors, storefront doors, and other locking doors that do not require other hardware.
3) Provide construction keying.
4) Provide key control system, including cabinet.

f. Closers:

1) Manufacturers: One of the follow:
   a) Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
   b) Norton Door Controls; an ASSA ABLOY Group company.
   c) Rixson Specialty Door Controls; an ASSA ABLOY Group company.
   d) Yale Security Inc.; an ASSA ABLOY Group company.

2) Mount closers on interior side (room side) of door opening. Provide regular-arm, parallel-arm, or top-jamb-mounted closers as necessary.
3) Adjustable delayed opening (accessible to people with disabilities) feature on closers.

g. Provide wall stops or floor stops for doors without closers.

h. Hardware Finishes:

1) Hinges: Matching finish of lockset/latchset.
2) Locksets, Latchsets, and Exit Devices: Satin stainless steel
3) Closers: Matching finish of lockset/latchset.
4) Other Hardware: Matching finish of lockset/latchset.

**PART 3 - EXECUTION**

3. INSTALLATION

a. Mount hardware in locations required to comply with governing regulations and according to SDI A250.8 and DHI WDHS.3.

b. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet.

c. Deliver keys to Owner.

**END OF SECTION 087100**

## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

1. SECTION REQUIREMENTS

   a. Submittals: Product Data.

### PART 2 - PRODUCTS

2. PERFORMANCE REQUIREMENTS

   a. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

   b. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

3. PANEL PRODUCTS

   a. Provide in maximum lengths available to minimize end-to-end butt joints.

   b. Interior Gypsum Board: ASTM C 1396/C 1396M, in thickness indicated, with manufacturer's standard edges. All material to be abuse resistant, mold and moisture resistant board on walls, and mold and moisture resistant board on ceilings.

   c. Cementitious Backer Units: ANSI A118.9, ASTM C 1288, or ASTM C 1325.

4. ACCESSORIES

   a. Trim Accessories: ASTM C 1047, formed from plastic. For exterior trim, use accessories formed from plastic.

      1) Provide cornerbead at outside corners unless otherwise indicated.
      2) Provide LC-bead (J-bead) at exposed panel edges.
      3) Provide control joints where indicated.

   b. Aluminum Accessories: Extruded-aluminum accessories indicated with manufacturer's standard corrosion-resistant primer.

   c. Joint-Treatment Materials: ASTM C 475/C 475M.

1) Joint Tape: Paper unless otherwise recommended by panel manufacturer.
2) Joint Compounds: Setting-type compounds.
3) Cementitious Backer Unit Joint-Treatment Materials: Products recommended by cementitious backer unit manufacturer.

d. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

1) Adhesive shall have a VOC content of 50 g/L or less.
2) Adhesive shall comply with Green Seal's GS-36 and 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."

e. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.

1) Sealants shall have a VOC content of 250 g/L or less.
2) Sealants 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."

f. Sound-Attenuation Blankets: ASTM C 665, Type I (unfaced).

**PART 3 - EXECUTION**

5. INSTALLATION

a. Install gypsum board to comply with ASTM C 840.

1) Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustical sealant.
2) Single-Layer Fastening Methods: Fasten gypsum panels to supports with screws.
3) Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with.

b. Install cementitious backer units to comply with ANSI A108.11.

c. Fire-Resistance-Rated Assemblies: Comply with requirements of listed assemblies.

d. Finishing Gypsum Board: ASTM C 840.

1) At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
2) At substrates for tile, provide Level 2 finish: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges.
3) Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.

4) Where indicated, provide Level 5 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges. Apply skim coat to entire surface.

e. Cementitious Backer Units: Finish according to manufacturer's written instructions.

**END OF SECTION 092900**

## SECTION 093000 - TILING

### PART 1 - GENERAL

1. SECTION REQUIREMENTS

   a. Submittals: Product Data and Samples.

   b. Obtain tile of each type and color or finish from same production run for each contiguous area

   c. 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 ceramic tile packages.]

### 2 - PRODUCTS

2. CERAMIC TILE

   a. Ceramic tile that complies with Standard grade requirements in ANSI A137.1, "Specifications for Ceramic Tile."

   b. Tile Type Unglazed, square-edged quarry tile.

      1) Product indicated on Drawings
      2) Trim Units: Coordinated with sizes and coursing of adjoining flat tile and matching characteristics of adjoining flat tile:

         a) Base: Coved with surface bullnose top edge.

3. INSTALLATION MATERIALS

   a. Low-Emitting Materials: Adhesives and fluid-applied waterproofing membranes shall have a VOC content of 65 g/L or less.

   b. Low-Emitting Materials: Adhesives and fluid-applied waterproofing membranes shall comply with Green Seal's GS-36 and 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."

   c. Setting and Grouting Materials: Comply with material standards in ANSI's "Specifications for the Installation of Ceramic Tile" that apply to materials and methods indicated.

      1) Water-Cleanable, Tile-Setting Epoxy.

      2) Grout Type: Water-Cleanable Epoxy.

**PART 3 - EXECUTION**

4. INSTALLATION

a. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

b. 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.

c. Lay tile in grid pattern unless otherwise indicated. Align joints where adjoining tiles on floor, base, walls, and trim are the same size.

d. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.

e. Install waterproofing to comply with ANSI A108.13.

f. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

**END OF SECTION 093000**

**SECTION 096600**
**TERRAZZO FLOORING**

## PART ONE: GENERAL

### 1.1 Summary

**1.1.1** Section includes general administrative and procedural requirements governing execution for terrazzo flooring. Section includes terrazzo flooring and accessories for products and applications, including those specified in other Sections where terrazzo flooring requirements are specified by reference to this Section including but not limited to, the following:

- **a.** Poured-in-place resinous matrix epoxy terrazzo flooring
- **b.** Poured in place integral formed terrazzo wall base
- **c.** Terrazzo Tile
- **d.** Terrazzo Base
- **e.** Accessories

### 1.2 Related Documents

**1.2.1** Construction Documents and general provisions of the Agreement Between Owner and Construction Manager and the Guaranteed Maximum Price (GMP) Amendment, including Division 00 General Conditions of the Contract for Construction and Supplementary Conditions and other Division 01 Specification Sections, applicable to this Section. All methods herein are to follow all applicable state and local code as well as installation standards.

**1.2.2** Comply with the requirements of the various specifications and standards referred to in the contract Plans and Specifications, except where they conflict with the specific requirements of these contract Plans and Specifications. Such reference specifications and standards.

### 1.3 Reference Standards

**1.3.1** American National Standards Institute (ANSI)

**1.3.2** American Society for Testing and Materials (ASTM)

**a.** ASTM C109/C109M Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens.
**b.** ASTM C150/C150M Standard Specification for Portland Cement
**c.** ASTM C241/C241M Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic
**d.** ASTM C501 Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
**e.** ASTM C97/C97M Absorption and Bulk Specific Gravity of Dimension Stone
**f.** ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission
**g.** ASTM D2047 Static Coefficient of Friction of Polish-Coated Floor Surfaces as measured by the James Machine.
**h.** ASTM E84 Standard Test Method for Surface Burning characteristics of Building Materials

**1.3.3** South Coast Air Quality Management District (SCAQMD)
**a.** SCAQMD Rule 1168 Adhesive and Sealant Applications
**b.** SCAQMD Rule 1113 Architectural Coatings

**1.3.4** National Terrazzo and Mosaic Association (NTMA)
**a.** NTMA Info Guide Terrazzo Reference Guide

## 1.4 Submittals

**1.4.1** All submittals shall be made in accordance to section 01 33 00 and as specified herein. Contractor is to submit the following to Owner and/or Consultant for approval prior to construction and fabrication:

**1.4.1.1** Shop Drawings/floor layouts/decorative patterns indicating expansion joint, control joint, isolation joint, perimeter joint and stress joint details; installation methods, transition details, manufacturer's installation instructions, detail of additional accessory items, profiles of each trim type, joint details and connections to adjoining work

**1.4.1.2** Submit three (3) samples for each type, class, finish and color:

**1.** Submit 12 inch square Samples of each color and pattern selected for each terrazzo flooring item specified.

**3.** Bases and Accessories: Submit 12 inch long Samples of each color selected/specified.

**1.4.1.3** Manufacturer's Certification to verify materials comply with specified requirements and suitable for intended application.

**1.4.1.4** Product data for each product. Submit manufacturer's specifications, catalog cuts, color range of specified product, product data sheets, installation instructions, and maintenance instructions.

**1.4.1.5** Setting materials, sealants and other misc. product required for complete installation: provide manufacturer product data and installation instructions.

**1.4.1.6** Warranty

**1.4.1.7** Maintenance material submittals: Furnish extra materials, trim and additional accessories that match and are from same production runs as products installed and that are packaged with protective covering and labels describing contents for storage.

## 1.5 Quality Assurance

**1.5.1** Control Samples: All products shall match the Engineer's control samples in all respects. Control samples require the Engineer's approval before they may be used as a standard.

**1.5.2** Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

**1.5.3** Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

**1.5.4** All work of this Section shall be performed by skilled installers of the trade and shall be of the highest quality specializing in installation of the products specified in this section with minimum five years of documented experience. Comply with applicable Industry Standards for all work and materials as specified. Such Industry Standards are to include but not be limited to the applicable provisions or standards in this section.

**1.5.5** Mock-Up - Typical Floor Panel: The Contractor shall install a typical floor panel, approximately 9-feet square in an appropriate location. Mock-up shall include joint treatment and other accessories as required for a finished installation. Provide a typical floor panel for each different type of resilient flooring and floor design indicated. Mock-up will be provided for evaluation of surface preparation techniques and application workmanship for each type using manufacturer approved installation methods. Do not proceed with production work until workmanship and finishes are approved by Architect and/or Owner and/or designer. Mock-up may remain as part of the work.

**1.5.6** Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

## 1.6 Coordination

**1.6.1** Coordinate installation of all tiling. Furnish shop drawings, templates, and directions for a complete installation. Deliver all required items, product and setting materials to project site in time for installation.

## 1.7 Delivery, Storage and Handling

**1.7.1** Deliver and store packaged materials in manufacturer's original unopened containers with seals unbroken and labels intact indicating brand names, color, pattern and quality designation of contents until time of use.

**1.7.2** Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture, heat, cold, direct sunlight, extreme temperature ranges, or other detrimental effects. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

**1.7.2** Do not open containers or remove labels until materials have been inspected and accepted for installation.

**1.7.3** Environmental Limitations: Do not proceed with installation when ambient and substrate temperature conditions are outside limits permitted by material manufacturers. Maintain ambient and substrate temperature as recommended by manufacturer.

# PART TWO: PRODUCTS

## 2.1 General

**2.1.1** Acceptable manufacturer/supplier as specified in contract drawings and/or Interior Design drawing set and specifications or an Owner approved equal. Approved equals and/or substitutions will only be approved for Work if submitted and approved in accordance with provisions of Section 01 25 00.

## 2.2 Materials

**2.2.1** Use only products for types, compositions, and other characteristics indicated. Provide terrazzo flooring complying with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

## 2.3 Products

**2.3.1** All products provided for installation shall be the products specified by designer and/or Architect unless noted otherwise. If material is no longer available or if a substitution is required, then, refer to section 01 25 00 for Substitution Procedures.

**2.3.2** Verify with drawing documents and schedules for tile specification number designations and product information as follows:

**1.** Composition
**2.** Size
**3.** Thickness
**4.** Finish
**5.** Formulated Mix
**6.** Color/Pattern
**7.** Slip Resistance must meet a Static coefficient of friction of 0.5 or greater is required, when tested in accordance with ASTM D2047.
**8.** Trim Units – if not specified it is the responsibility of the contractor to suggest compatible trim and submit for approval prior to installation.

**2.3.3** Topping: Comply with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo system indicated for matrix and aggregate proportions and mixing.

**2.3.4** Epoxy Resin: mixed in accordance with manufacturer’s recommendations and tested. Must meet ASTM standards for hardness, tensile strength, compressive strength and chemical resistance.

**2.3.5** Portland Cement Terrazzo Flooring: Provide Portland cement conforming to ASTM C150/C150M, Type I, of colors required to match NTMA Information Guide.

**2.3.6** Marble Chips: size of marble chips to conform to NTMA gradation standards, abrasion and impact resistance when testing in accordance to ASTM C131-89.

**2.3.7** Precast Terrazzo: precuts are to be provided from specified vendor unless noted otherwise. Substitutions can be recommended as needed, see section 01 25 00 for substitution procedures.

**1.** Manufacturers: Subject to compliance with requirements

**2.** Precast Terrazzo Base:

**a.** Minimum thickness per drawings

**b.** Reinforced and cast in maximum lengths possible but not less than 36”

**c.** Comply with NTMA's written recommendations for fabricating precast terrazzo base units in sizes and profiles indicated.

**d.** Type: Coved with a ¾” minimum radius, straight or splayed; refer to drawings

**e.** Outside corner units are to be provided where required

**3.** Precast Terrazzo Units:

**a.** Minimum ¾” thick, reinforced Portland cement terrazzo units.

**b.** Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated.

**c.** Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer.

**d.** Finish exposed-to-view edges and reveals to match face finish.

**e.** Ease exposed edges to 1/8-inch (3.2-mm) radius.

**f.** Precast Terrazzo units includes but is not limited to the following types: Tiles, planks, stair treads, thresholds, sills, benches, planters, countertops, shower bases

**2.3.8** Provide terrazzo tile of the indicated colors and consisting of marble or granite chips embedded in a flexible or rigid thermoset resin matrix. Submit drawings indicating pattern, size, style, and color of tiles and two 150 by 150 mm 6 by 6 inch minimum samples of each color and pattern of terrazzo tile to be used. Provide tiles with a polished, polished and honed, textured or honed finish with uniform color distribution of chips.

**2.3.9** Accessories:

Provide extruded metal material and size as indicated in drawings.

**1.** Standard Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.

**2.** Heavy-Top Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.

**3.** Heavy-Top Angle Divider Strips: One-piece, L-type angle strips with anchoring device and in depth required for topping thickness indicated.

**4.** Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.

**5.** Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. The following types of accessory strips are to be provided as required for a complete installation:

**a.** Base-bead strips for exposed top edge of terrazzo base.

**b.** Edge-bead strips for exposed edges of terrazzo

**c.** Nosings for terrazzo stair treads and landings

**6.** Abrasive Strips: abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.

## 2.4 Misc. Setting Materials

Provide and install additional items for a sound installation. Additional setting materials for installation include but not limited to the following:

**2.4.1** Strip Adhesive: Recommended by manufacturer for this use.

**2.4.2** Anchoring Devices:

**1.** Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.

**2.** Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.

**2.4.3** Isolation and Expansion-Joint Material: Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state

**2.4.4** Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.

**2.4.5** Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated.

**1.** Surface Friction: Not less than 0.6 according to ASTM D 2047.

**2.** Acid-Base Properties: With pH factor between 7 and 10.

**3.** Shall not discolor or amber.

**4.** Flash point: ASTM D-56, 80 degrees Fahrenheit minimum, where applicable.

**5.** U/L listed as “Slip Resistant.”

**6.** Sealers shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART THREE: EXECUTION

### 3.1 Examination

**3.1.1** Do not begin installation until substrates have been properly prepared.

**3.1.2** Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Subfloor and substrate surfaces shall be firm, dry, clean, and free from defects or irregularities that may impair bond or jeopardize the quality of the work.

**3.1.3** If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

**3.1.4** Examine materials before installation. Reject materials that are defective and/or damaged.

**3.1.5** Proceed with installation only after unsatisfactory conditions have been corrected.

**3.1.6** Do not take any corrective action without written permission from the Client, Architect.

**3.1.7** Determine the suitability of the concrete subfloor for receiving the terrazzo flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F1869 or ASTM F2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

**3.1.8** Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

## 3.2 Preparation

**3.2.1** Protect surrounding work from damage.

**3.2.2** Roughen concrete substrates via shot-blas or diamond drinding before installing terrazzo system according to NTMA's written recommendations.

**3.2.3** Treat all stress cracks with Crack Isolation System as specified by the architect following the manufacturer installation instructions. Install 100% or partial coverage when required and indicated.

## 3.3 Installation

**3.3.1** Clean and saturate concrete surfaces with water in accordance with NTMA Info Guide. Do not treat concrete substrate to receive bonded terrazzo with curing agent or additives which would preclude bonding. Remove excess water from the subfloor before slushing and brooming with neat cement paste. Place the underbed on the concrete subfloor and screed to an elevation 13 mm 1/2 inch below the finished floor. Install divider strips in the semi-plastic underbed. Firmly trowel the underbed along the edges to insure positive anchorage of the divider strips. Install control joint strips over subfloor expansion joints and extend the full depth of the underbed.

**3.3.2** Set Divider Strips in accordance with layout indicated while underbed is still plastic. Set strips to straight lines and to the proper level to ensure that tops of strips will show uniformly after completing grinding and finishing operations. Fit joints and intersections tight. Where divisions in field work are not shown, divide field work into squares or rectangles of uniform size and not more than 1800 mm 6 feet on a side. Divide borders by strips to coincide with the layout of division strips in the field of floors. Place edging strips at doorways between terrazzo and other types of flooring and along the edges of terrazzo borders adjoining other types of floor finishes or floor coverings. Place expansion strips over control joints, construction joints, and expansion joints.

**3.3.3** Placing Terrazzo Tipping: Slush and broom the underbed in accordance with NTMA Info Guide with neat cement paste of the same color as required for the topping. Place the topping in panels formed by divider strips and trowel level with the top of the strips. Seed the troweled surface with chips in the same color proportions as contained in the terrazzo mix, trowel and roll

with heavy rollers until excess water has been extracted. Trowel the terrazzo to a uniform surface disclosing the lines of the divider strips.

**3.3.4** Cure the terrazzo until the topping develops sufficient strength to prevent lifting or pulling of terrazzo chips during grinding. Keep the completed terrazzo continuously moist and free of traffic during the curing period. Cure by covering with a liquid membrane-forming compound, sheet materials, wet sand, or sprinkling with water.

**3.3.5** Finish in accordance with NTMA Info Guide. After curing the grout coat for a minimum of 72 hours, grind the floor using a No. 80 or finer grit stone. In the latter stages of grinding, use grit stones or other abrasive in the grinding machine of a grain or fineness that will give the surface a honed finish. Grind and rub by hand small areas, inaccessible portions, and corners that cannot be reached by the grinding machine. The honed surface of finished terrazzo must show not less than
70 percent of the area as exposed aggregate evenly distributed, and conform in appearance to the approved samples.

**3.3.6** After topping has cured, machine gring the terrazzo using the wet method, to a true even surface using No. 24 or finer grit followed by No. 80 grit or finer grit stone. Finish floor surface must not vary by more than 2mm/meter 1/4 inch in 10 feet.

**3.3.7** After rough grinding, cleanse and rinse the floor with clean water. After removing excess rinse water, grout the floor using identical Portland cement, color and pigments as used in the topping taking care to fill voids. After the grout has attained its initial set, cure the surface for a minimum of 72 hours.

**3.3.8** After grout has cured, gring the surface with fine grit stones until all grout is removed from the surface. Upon completion of grinding, the terrazzo flooring must show a minimum of 70 percent of marble chips. Submit two 150 x 150 mm 6 x 6 inch (minimum) samples of each color of terrazzo

**3.3.9** Wash the terrazzo with a neutral cleaner and, where required, clean with a fine abrasive to remove stains or cement smears. Rinse the cleaned surface. When dry, apply a terrazzo sealer in accordance with the manufacturer's directions.

**3.3.10** Install tile in accordance with the manufacturer's approved installation instructions, except as specified herein. Lay tile symmetrical about center lines of rooms or areas. Joints must be tight, inconspicuous as possible, and in alignment. Cut tile to fit snugly at pipes and other vertical surfaces. Seal joints at pipes with adhesive. Remove spots or smears of adhesive immediately. Entire surface of finished tile floor must be smooth, straight, and free from bleeding adhesive, buckles, waves, or projecting tile edges upon completion. Bleeding of adhesive on finished floors is cause for rejection by the Contracting Officer. Remove and replace damaged or rejected tiles.

**3.3.11** Where seams occur at right angle corners, cut pieces that butt each other from the same roll.

## 4 Protection, Cleaning and Repairs

**3.4.1** Cleaning: Immediately upon completion of flooring installation in a room or an area, dry/clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and/or finish in accordance with manufacturer's written instructions.

**3.4.2** Protect installed work with Kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

**3.4.3** Prohibit foot and wheel traffic from floors for at least 72 hours after installation.

**3.4.4** Before final inspection, remove protective coverings and clean per manufacturer’s recommendations.

**3.4.5** Remove and replace any items which are abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

**END OF SECTION**

## SECTION 096723-RESINOUS FLOORING

### PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes the following:

1. Resinous flooring system as shown on the drawings and in schedules.

B. Related sections include the following:

1. Cast-in-Place Concrete, section 03 30 00
2. Concrete Curing, section 03 39 00

1.3 SYSTEM DESCRIPTION

A. The work shall consist of preparation of the substrate, the furnishing and application of a cementitious urethane based self-leveling seamless flooring system with Macro or Micro size decorative colored chip broadcast, epoxy resin broadcast and aliphatic resinous topcoat.
B. The system shall have the color and texture as specified by the Owner with a nominal thickness of 3/16 inch. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.
C. Cove base (if required) to be applied where noted on plans and per manufacturers standard details unless otherwise noted

1.4 SUBMITTALS

A. Product Data: Latest edition of Manufacturer's literature including performance data and installation procedures.
B. Manufacturer’s Material Safety Data Sheet (MSDS) for each product being used.
C. Samples: A 3 x 3 inch square sample of the proposed system. Color, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.

1.5 QUALITY ASSURANCE

A. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of epoxy and urethane industrial flooring and related materials.
B. The Applicator shall have experience in installation of the flooring system as confirmed by the manufacturer in all phases of surface preparation and application of the product specified.
C. No requests for substitutions shall be considered that would change the generic type of the specfied System.
D. System shall be in compliance with requirements of United States Department of Agriculture (USDA),
Food, Drug Administration (FDA), and local Health Department.
E. A pre-installation conference shall be held between Applicator, General Contractor and the Owner to review and clarification of this specification, application procedure, quality control, inspection and acceptance criteria and production schedule.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping
   1. All components of the system shall be delivered to the site in the Manufacturer's packaging, clearly identified with the product type and batch number.

B. Storage and Protection

   1. The Applicator shall be provided with a dry storage area for all components. The area shall be between 60 F and 85 F, dry, out of direct sunlight and in accordance with the Manufacturer's recommendations and relevant health and safety regulations.
   2. Copies of Material Safety Data Sheets (MSDS) for all components shall be kept on site for review by the Engineer or other personnel.

C. Waste Disposal

   1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.7 PROJECT CONDITIONS

A. Site Requirements

   1. Application may proceed while air, material and substrate temperatures are between 60 F and 85 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
   2. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
   3. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.

B. Conditions of new concrete to be coated with cementitious urethane material.

   1. Concrete shall be moisture cured for a minimum of 3 days and have fully cured a minimum of 5 days in accordance with ACI-308 prior to the application of the coating system pending moisture tests.
   2. Concrete shall have a flat rubbed finish, float or light steel trowel finish (a hard steel trowel finish is neither necessary nor desirable).
   3. Sealers and curing agents should not to be used.
   4. Concrete shall have a minimum design strength of 3,500 psi. and a maximum water/cement ratio of 0.45
   5. Concrete surfaces on grade shall have been constructed with a vapor barrier to protect against the effects of vapor transmission and possible delamination of the system.

C. Safety Requirements

   1. The Owner shall be responsible for the removal of foodstuffs from the work area.
   2. Non-related personnel in the work area shall be kept to a minimum.

1.8 WARRANTY

A. Dur-A-Flex, Inc. warrants that material shipped to buyers at the time of shipment substantially free from material defects and will perform substantially to Dur-A-Flex, Inc. published literature if used in accordance with the latest prescribed procedures and prior to the expiration date.
B. Dur-A-Flex, Inc. liability with respect to this warranty is strictly limited to the value of the material purchase.

**PART 2 – PRODUCTS**

2.1 FLOORING

A. Dur-A-Flex, Inc, Hybri-Flex AC (self leveling broadcast colored chip), epoxy resin broadcast and aliphatic resinous topcoat seamless flooring system.
1. System Materials:
a. Topping: Dur-A-Flex, Inc, Poly-Crete SL resin, SL hardener and SL aggregate.
b. The colored chips shall be Dur-A-Flex, Inc. Micro colored chips.
c. Broadcast coat: Dur-A-Glaze #4 resin and hardener.
d. Topcoat: Dur-A-Flex, Inc. Accelera resin and hardener.

2. Patch Materials
a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Poly-Crete MD (up to ¼ inch).
b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Poly-Crete WR.

2.2 MANUFACTURER

A. Dur-A-Flex, Inc., 95 Goodwin Street, East Hartford, CT 06108, Phone: (860) 528-9838, Fax: (860) 528-2802
B. Manufacturer of Approved System shall be single source and made in the USA.

2.3 PRODUCT REQUIREMENTS

| | | |
|---|---|---|
| A. | Topping | Poly-Crete SL |
| 1. | Percent Reactive | 100% |
| 2. | VOC | 0 g/L |
| 3. | Bond Strength to Concrete ASTM D 4541 | 400 psi, substrates fails |
| 4. | Compressive Strength, ASTM C 579 | 9,000 psi |
| 5. | Tensile Strength, ASTM D 638 | 2,175 psi |
| 6. | Flexural Strength, ASTM D 790 | 5,076 psi |
| 7. | Impact Resistance @ 125 mils, MIL D-3134, No visible damage or deterioration | 160 inch lbs |
| B. | Broadcast Coat | Dur-A-Glaze #4 |
| 1. | Percent Solids | 100 % |
| 2. | VOC | 3.8 g/L |
| 3. | Compressive Strength, ASTM D 695 | 11,200 psi |
| 4. | Tensile Strength, ASTM D 638 | 2,100 psi |
| 5. | Flexural Strength, ASTM D 790 | 5,100 psi |
| 6. | Abrasion Resistance, ASTM D 4060 C-10 Wheel, 1,000 gm load, 1,000 cycles | 29 mg loss |
| 7. | Flame Spread/NFPA-101, ASTM E 84 | Class A |
| 8. | Impact Resistance MIL D-24613 | 0.0007 inches, no cracking or delamination |
| 9. | Water Absorption. MIL D-24613 | Nil |
| 10. | Potlife @ 70 F | 20 minutes |
| C. | Topcoat | Accelera |
| 1. | Percent Solids | 100 % |
| 2. | VOC | 0 g/L |
| 3. | Bond Strength to Concrete ASTM D 4541 | 400 psi, substrates fails |
| 4. | Hardness, Shore D ASTM D2240 | 70 |

| | | |
|---|---|---|
| 5. | Compressive Strength, ASTM C579 | 18,000 psi |
| 6. | Tensile Strength, ASTM D638 | 2,600 psi |
| 7. | Abrasion Resistance, ASTM D4060<br>C-17 Wheel, 1,000 gm load, 1,000 cycles | 27 mg loss |
| 8. | Potlife @ 70 F | 7 – 10 minutes |
| 9. | Gloss (ASTM D523) 60° | 90 |
| 10. | Coefficient of Friction (ASTM D2047) | 0.8 |

**PART 3 – EXECUTION**

3.1 EXAMINATION

A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions affecting flooring performance.

1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

3.2 PREPARATION

A. General

1. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss,
algae growth, laitance, friable matter, dirt, and bituminous products.
2. Moisture Testing: Perform tests recommended by manufacturer and as follows.
. a. Perform anhydrous calcium chloride test ASTM F 1869-98. Application will proceed only when the vapor/moisture emission rates from the slab is less than and not higher than 20 lbs/1,000 sf/24 hrs.
   b. Perform relative humidity test using is situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 99% relative humidity level measurement.
   c. If the vapor drive exceeds 99% relative humidity or 20 lbs/1,000 sf/24 hrs then the Owner and/or Engineer shall be notified and advised of additional cost for the possible installation of a vapor mitigation system that has been approved by the manufacturer or other means to lower the value to the acceptable limit.
3. Mechanical surface preparation
   a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
   b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
   c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
   d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
4. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

3.3 APPLICATION

A. General

1. The system shall be applied in Four distinct steps as listed below:
   a. Substrate preparation
   b. Topping/overlay application with colored chip broadcast.
   c. Resin application with colored chip broadcast.
   d. Topcoat application.
2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

B. Topping

1. The topping shall be applied as a self-leveling system as specified by the Architect. The topping shall be applied in one lift with a nominal thickness of 1/8 inch.
2. The topping shall be comprised of three components, a resin, hardener and filler as supplied by the Manufacturer.
3. The hardener shall be added to the resin and thoroughly dispersed by suitably approved mechanical means. SL Aggregate shall then be added to the catalyzed mixture and mixed in a manner to achieve a homogenous blend.
4. The topping shall be applied over horizontal surfaces using ½ inch “v” notched squeegee, trowels or other systems approved by the Manufacturer.
5. Immediately upon placing, the topping shall be degassed with a loop roller.
6. Colored chips shall be broadcast to excess into the wet material, Microchips at the rate of 0.15 lbs/sf.
7. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

C. Broadcast Coat

1. The 2nd broadcast coat shall be applied as specified by the Architect.
2. The broadcast coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer and mixed in the ratio of 2 parts resin to 1 part hardener.
3. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
6. The broadcast coat shall be applied over horizontal surfaces using squeegee and back rolled at the rate of 100 sf/gal.
5. Colored chips shall be broadcast to excess into the wet material, Microchips at the rate of 0.15 lbs./sf..
6. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

E. Topcoat

1. The grout coat shall be comprised of ACCELERA resin and hardener mixed per the manufacturer’s instructions.

2. The Top coat shall be applied using a squeegee and cross rolled with a 3/8 inch nap roller at the rate of 65 SF/kit. Add 1-2 oz. of Duragrip additive per mixed kit of Accelera Topcoat to increase slip resistance.

The finished floor will have a nominal thickness of 3/16 inch.

*** Specifier's Note *** If smoother finisher is required, apply a second Accelera top coat using a squeegee and cross roll with a 3/8 inch nap roller at the rate of 200 SF/kit.

3.4 FIELD QUALITY CONTROL

A. Tests, Inspection

1. The following tests shall be conducted by the Applicator:
   a. Temperature
      1. Air, substrate temperatures and, if applicable, dew point.
   b. Coverage Rates
      1. Rates for all layers shall be monitored by checking quantity of material used against the area covered.

3.5 CLEANING AND PROTECTION

A. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
B. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

**END OF SECTION 096723**

**SECTION 099000**
**INTERIOR, EXTERIOR AND INDUSTRIAL PAINTS AND COATINGS**

## PART 1 - GENERAL

SCHEDULE 0 - SECTION INCLUDES

PRODUCT DATA SHEET 0 - Interior paint and coatings systems including surface preparation.

PRODUCT DATA SHEET 1 - Exterior paint and coatings systems including surface preparation.

SCHEDULE 1 - REFERENCES

PRODUCT DATA SHEET 0 - Steel Structures Painting Council (SSPC):
- 1.1 SSPC-SP 1 - Solvent Cleaning.
- 1.2 SSPC-SP 2 - Hand Tool Cleaning.
- 1.3 SSPC-SP 3 - Power Tool Cleaning.
- 1.4 SSPC-SP5/NACE No. 1, White Metal Blast Cleaning.
- 1.5 SSPC-SP6/NACE No. 3, Commercial Blast Cleaning.
- 1.6 SSPC-SP7/NACE No. 4, Brush-Off Blast Cleaning.
- 1.7 SSPC-SP10/NACE No. 2, Near-White Blast Cleaning.
- 1.8 SSPC-SP11, Power Tool Cleaning to Bare Metal.
- 1.9 SSPC-SP12/NACE No. 5, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating.
- 1.10 SSPC-SP 13 / NACE No. 6 Surface Preparation for Concrete.

PRODUCT DATA SHEET 1 - Material Safety Data Sheets / Environmental Data Sheets: Per manufacturer's MSDS/EDS for specific VOCs (calculated per 40 CFR 59.406). VOCs may vary by base and sheen.

PRODUCT DATA SHEET 2 - California Department of Public Health (CDPH):
- 1.1 CDPH v1.1-2010 and V1.2-2017

PRODUCT DATA SHEET 3 - LEEDv4 EQ Credit: Indoor Environmental Quality-Low Emitting Materials

SCHEDULE 2 - SUBMITTALS

PRODUCT DATA SHEET 0 - Submit under provisions of Section 01 30 00 - Administrative Requirements.

PRODUCT DATA SHEET 1 - Product Data: For each paint system indicated, including.
- 1.1 Product characteristics.
- 1.2 Surface preparation instructions and recommendations.
- 1.3 Primer requirements and finish specification.
- 1.4 Storage and handling requirements and recommendations.
- 1.5 Application methods.
- 1.6 Cautions for storage, handling and installation.

PRODUCT DATA SHEET 2 - Selection Samples: Submit a complete set of color chips that represent the full range of manufacturer's products, colors and sheens available.

PRODUCT DATA SHEET 3 - Verification Samples: For each finish product specified, submit samples that represent actual product, color, and sheen.

PRODUCT DATA SHEET 4 - Only submit complying products based on project requirements (i.e. LEED). One must also comply with the regulations regarding VOCs (CARB, OTC, SCAQMD, LADCO). To ensure compliance with district regulations and other rules, businesses that perform coating activities should contact the local district in each area where the coating will be used.

PRODUCT DATA SHEET 5 - USGBC LEED V4 Submittals:

1.1 MRc2 Environmental Product Declaration Product Language: Products shall be selected with a preference to products that have product-specific environmental product declaration documentation.

1.2 EQc2 Low Emitting Materials: The VOC content of all adhesives, sealants, paints and coatings in this Section shall not exceed the VOC limits established in Division 01 Sustainable Design sections.

SCHEDULE 3 - QUALITY ASSURANCE

PRODUCT DATA SHEET 0 - Installer Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

PRODUCT DATA SHEET 1 - Paint exposed surfaces. If a color of finish, or a surface is not specifically mentioned, Architect will select from standard products, colors and sheens available.

PRODUCT DATA SHEET 2 - Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels unless indicated.

PRODUCT DATA SHEET 3 - Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1.1 Finish surfaces for verification of products, colors and sheens.

1.2 Finish area designated by Architect.

1.3 Provide samples that designate primer and finish coats.

1.4 Do not proceed with remaining work until the Architect approves the mock-up.

SCHEDULE 4 - DELIVERY, STORAGE, AND HANDLING

PRODUCT DATA SHEET 0 - Delivery: Deliver manufacturer's unopened containers to the work site. Packaging shall bear the manufacturer's name, label, and the following list of information.

1.1 Product name and type (description).

1.2 Application and use instructions.

1.3 Surface preparation.

1.4 VOC content.

1.5 Environmental handling.

1.6 Batch date.

1.7 Color number.

PRODUCT DATA SHEET 1 - Storage: Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

PRODUCT DATA SHEET 2 - Store materials in an area that is within the acceptable temperature range, per manufacturer's instructions. Protect from freezing.

PRODUCT DATA SHEET 3 - Handling: Maintain a clean, dry storage area, to prevent contamination or damage to the coatings.

SCHEDULE 5 - PROJECT CONDITIONS

PRODUCT DATA SHEET 0 - Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

SCHEDULE 6 - EXTRA MATERIALS

PRODUCT DATA SHEET 0 - Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

PRODUCT DATA SHEET 1 - Furnish Owner with an additional one percent of each material and color, but not less than 1 gal (3.8 l) or 1 case, as appropriate.

**PART 2 - PRODUCTS**

SCHEDULE 0 - MANUFACTURERS

PRODUCT DATA SHEET 0 - Acceptable Manufacturer: Sherwin-Williams, which is located at: 101 Prospect Ave.; Cleveland, OH 44115; Toll Free Tel: 800-524-5979; Tel: 216-566-2000; Fax: 440-826-1989; Email: request infospecifications@sherwin.com; Web:www.swspecs.com.

PRODUCT DATA SHEET 1 - Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

SCHEDULE 1 - APPLICATIONS/SCOPE

PRODUCT DATA SHEET 0 - Interior Paints and Coatings: (LEED v4 EQ Credit: Indoor Environmental Quality-Low Emitting Materials)

2.1 Concrete: Poured, precast, tilt-up, cast-in-place, cement board, plaster.

PRODUCT DATA SHEET 1 - Exterior Paints and Coatings:

2.1 Concrete: Cementitious siding, flexboard, transite, and shingles (non-roof).
2.2 Masonry: Concrete masonry units, cinder or concrete block.
2.3 Concrete: Concrete floors, patios, porches, steps and platforms, (non-vehicular).
2.4 Metal: Aluminum, galvanized steel.
2.5 Metal: Miscellaneous iron, ornamental iron, ferrous metal.
2.6 Wood: Floors (non-vehicular), and platforms.
2.7 Wood: Siding, trim, shutters, sash, and miscellaneous hardboard.
2.8 Architectural PVC, plastic, fiberglass.
2.9 Drywall: Gypsum board, and exterior drywall.
2.10 Vinyl: Siding, EIFS, synthetic stucco.

SCHEDULE 2 - PAINT MATERIALS - GENERAL

PRODUCT DATA SHEET 0 - Paints and Coatings:

2.1 Unless otherwise indicated, provide factory-mixed coatings. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
2.2 For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color. Or follow manufactures product instructions for optimal color conformance.

PRODUCT DATA SHEET 1 - Primers: Where the manufacturer offers options on primers for a

particular substrate, use primer categorized as "best" by the manufacturer.

PRODUCT DATA SHEET 2 - Coating Application Accessories: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required, per manufacturer's specifications.

PRODUCT DATA SHEET 3 - Color: Refer to Finish Schedule for paint colors, and as selected.

PRODUCT DATA SHEET 4 - LEED Requirements: LEED v4 EQ Credit: Indoor Environmental Quality-Low Emitting Materials.

SCHEDULE 3 - INTERIOR PAINT SYSTEMS (LEED-V4 NC/CI/CS COMPLIANT)

PRODUCT DATA SHEET 0 - CONCRETE: Walls and Ceilings, Poured Concrete, Precast Concrete, Unglazed Brick, Cement Board, Tilt-Up, Cast-In-Place including Plaster Walls and Ceilings.

2.1 Epoxy Systems (Water Based):

A. Egg-Shell/Low Luster Finish:

1. 1st Coat: S-W Pro Industrial Water Based Catalyzed Epoxy, B73-360 Series.
2. 2nd Coat: S-W Pro Industrial Water Based Catalyzed Epoxy, B73-360 Series (5 mils wet, 2.0 mils dry per coat).

SCHEDULE 4 - EXTERIOR PAINT SYSTEMS

PRODUCT DATA SHEET 0 - CONCRETE (Cementitious Siding, Flexboard, Transite Board, Shingles (Non-Roof), Common Brick, Stucco, Tilt-up, Precast, and Poured-in-place Cement).

2.1 Latex Systems:

A. Satin Finish:

1. 1st Coat: S-W Loxon Concrete and Masonry Primer Sealer, LX02W50 (5.3-8.0 mils wet, 2.1-3.2 dry).
2. 2nd Coat: S-W Superpaint Exterior Latex Satin, A89 Series.
3. 3rd Coat: S-W Superpaint Exterior Latex Satin, A89 Series (4.0 mils wet, 1.44 mils dry per coat).

2.2 Anti-Graffiti Coating:

A. Clear Satin Finish:

1. 1st Coat: S-W 2K Waterbased Urethane Anti-Graffiti Coating, Satin Series B65-195/B65V195.
2. 2nd Coat: S-W 2K Waterbased Urethane Anti-Graffiti Coating, Satin Series B65-195/B65V195. (4.0-8.0 mils wet, 2.0-4.0 mils dry per coat).

**PART 3 - EXECUTION**

SCHEDULE 0 - EXAMINATION

PRODUCT DATA SHEET 0 - Do not begin installation until substrates have been properly prepared; notify Architect of unsatisfactory conditions before proceeding. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

PRODUCT DATA SHEET 1 - Proceed with work only after conditions have been corrected and approved by all parties, otherwise application of coatings will be considered as an acceptance of surface conditions.

PRODUCT DATA SHEET 2 - Previously Painted Surfaces: Verify that existing painted surfaces do not contain lead based paints, notify Architect immediately if lead based paints are encountered.

SCHEDULE 1 - SURFACE PREPARATION

PRODUCT DATA SHEET 0 - General: Surfaces shall be dry and in sound condition. Remove oil, dust, dirt, loose rust, peeling paint or other contamination to ensure good adhesion.

3.1 Prior to attempting to remove mildew, it is recommended to test any cleaner on a small, inconspicuous area prior to use. Bleach and bleaching type cleaners may damage or discolor existing paint films. Bleach alternative cleaning solutions are advised.

3.2 Remove mildew before painting by washing with a solution of 1 part liquid household bleach and 3 parts of warm water. Apply solution and scrub the mildewed area. Allow solution to remain on the surface for 10 minutes. Rinse thoroughly with clean water and allow surface to dry before painting. Wear protective glasses or goggles, waterproof gloves, and protective clothing. Quickly wash off any of the mixture that comes in contact with your skin. Do not add detergents or ammonia to the bleach/water solution.

3.3 Remove items including but not limited to thermostats, electrical outlets, switch covers and similar items prior to painting. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

3.4 No exterior painting should be done immediately after a rain, during foggy weather, when rain is predicted, or when the temperature is below 50 degrees F (10 degrees C), unless products are designed specifically for these conditions. On large expanses of metal siding, the air, surface and material temperatures must be 50 degrees F (10 degrees F) or higher to use low temperature products.

PRODUCT DATA SHEET 1 - Aluminum: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.

PRODUCT DATA SHEET 2 - Block (Cinder and Concrete): Remove all loose mortar and foreign material. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement, and hardeners. Concrete and mortar must be cured at least 30 days at 75 degrees F (24 degrees C). The pH of the surface should be between 6 and 9, unless the products are designed to be used in high pH environments. On tilt-up and poured-in-place concrete, commercial detergents and abrasive blasting may be necessary to prepare the surface. Fill bug holes, air pockets, and other voids with a cement patching compound.

PRODUCT DATA SHEET 3 - Concrete, SSPC-SP13 or NACE 6: This standard gives requirements for surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems. The requirements of this standard are applicable to all types of cementitious surfaces including cast-in-place concrete floors and walls, precast slabs, masonry walls, and shotcrete surfaces. An acceptable prepared concrete surface should be free of contaminants, laitance, loosely adhering concrete, and dust, and should provide a sound, uniform substrate suitable for the application of protective coating or lining systems.

PRODUCT DATA SHEET 4 - Cement Composition Siding/Panels: Remove all surface contamination by washing with an appropriate cleaner, rinse thoroughly and allow to dry. Existing peeled or checked paint should be scraped and sanded to a sound surface. Pressure clean, if needed, with a minimum of 2100 psi pressure to remove all dirt, dust, grease, oil, loose particles, laitance, foreign material, and peeling or defective coatings. Allow the surface to dry thoroughly. The pH of the surface should be between 6 and 9, unless the products are designed to be used in high pH environments.

PRODUCT DATA SHEET 5 - Copper and Stainless Steel: Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP 2, Hand Tool Cleaning.

PRODUCT DATA SHEET 6 - Exterior Composition Board (Hardboard): Some composition boards may

exude a waxy material that must be removed with a solvent prior to coating. Whether factory primed or unprimed, exterior composition board siding (hardboard) must be cleaned thoroughly and primed with an alkyd primer.

PRODUCT DATA SHEET 7 - Drywall - Exterior: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth and all dust removed prior to painting. Exterior surfaces must be spackled with exterior grade compounds.

PRODUCT DATA SHEET 8 - Drywall - Interior: Must be clean and dry. All nail heads must be set and spackled. Joints must be taped and covered with a joint compound. Spackled nail heads and tape joints must be sanded smooth and all dust removed prior to painting.

PRODUCT DATA SHEET 9 - Galvanized Metal: Clean per SSPC-SP1 using detergent and water or a degreasing cleaner to remove greases and oils. Apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP16 is necessary to remove these treatments.

PRODUCT DATA SHEET 10 - Plaster: Must be allowed to dry thoroughly for at least 30 days before painting, unless the products are designed to be used in high pH environments. Room must be ventilated while drying; in cold, damp weather, rooms must be heated. Damaged areas must be repaired with an appropriate patching material. Bare plaster must be cured and hard. Textured, soft, porous, or powdery plaster should be treated with a solution of 1 pint household vinegar to 1 gallon of water. Repeat until the surface is hard, rinse with clear water and allow to dry.

PRODUCT DATA SHEET 11 - Steel: Structural, Plate, And Similar Items: Should be cleaned by one or more of the surface preparations described below. These methods are used throughout the world for describing methods for cleaning structural steel. Visual standards are available through the Society of Protective Coatings. A brief description of these standards together with numbers by which they can be specified follow.

3.1 Solvent Cleaning, SSPC-SP1: Solvent cleaning is a method for removing all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants. Solvent cleaning does not remove rust or mill scale. Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Be sure to allow adequate ventilation.

3.2 Hand Tool Cleaning, SSPC-SP2: Hand Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Before hand tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1.

3.3 Power Tool Cleaning, SSPC-SP3: Power Tool Cleaning removes all loose mill scale, loose rust, and other detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Before power tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP1.

3.4 White Metal Blast Cleaning, SSPC-SP5 or NACE 1: A White Metal Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.

3.5 Commercial Blast Cleaning, SSPC-SP6 or NACE 3: A Commercial Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 33 percent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-

SP1 or other agreed upon methods.

3.6 Brush-Off Blast Cleaning, SSPC-SP7 or NACE 4: A Brush-Off Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP 1 or other agreed upon methods.

3.7 Power Tool Cleaning to Bare Metal, SSPC-SP11: Metallic surfaces that are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted. Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP1, Solvent Cleaning, or other agreed upon methods.

3.8 Near-White Blast Cleaning, SSPC-SP10 or NACE 2: A Near White Blast Cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining. Staining shall be limited to no more than 5 percent of each square inch of surface area and may consist of light shadows, slight streaks, or minor discoloration caused by stains of rust, stains of mill scale, or stains of previously applied paint. Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP1 or other agreed upon methods.

3.9 High- and Ultra-High Pressure Water Jetting for Steel and Other Hard Materials: SSPC-SP12 or NACE 5: This standard provides requirements for the use of high- and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only without the addition of solid particles in the stream.

3.10 Water Blasting, SSPC-SP12/NACE No. 5: Removal of oil grease dirt, loose rust, loose mill scale, and loose paint by water at pressures of 2,000 to 2,500 psi at a flow of 4 to 14 gallons per minute.

PRODUCT DATA SHEET 12 - Vinyl Siding, Architectural Plastics, EIFS and Fiberglass: Clean vinyl siding thoroughly by scrubbing with a warm, soapy water solution. Rinse thoroughly. Do not paint vinyl siding with any color darker than the original color, unless the paint system features Sherwin-Williams VinylSafe technology. Painting with darker colors that are not Sherwin-Williams VinylSafe may cause siding to warp. Follow all painting guidelines of the vinyl manufacturer when painting. Only paint properly installed vinyl siding. Deviating from the manufacturer's painting guidelines may cause the warranty to be voided.

PRODUCT DATA SHEET 13 - Stucco: Must be clean and free of any loose stucco. If recommended procedures for applying stucco are followed, and normal drying conditions prevail, the surface may be painted in 30 days. The pH of the surface should be between 6 and 9, unless the products are designed to be used in high pH environments such as Loxon.

PRODUCT DATA SHEET 14 - Wood: Must be clean and dry. Prime and paint as soon as possible. Knots and pitch streaks must be scraped, sanded, and spot primed before a full priming coat is applied. Patch all nail holes and imperfections with a wood filler or putty and sand smooth.

SCHEDULE 2 - INSTALLATION

PRODUCT DATA SHEET 0 - Apply all coatings and materials with the manufacturer's specifications in mind. Mix and thin coatings according to manufacturer's recommendations.

PRODUCT DATA SHEET 1 - Do not apply to wet or damp surfaces. Wait at least 30 days before applying to new concrete or masonry. Or follow manufacturer's procedures to apply appropriate coatings prior to 30 days. Test new concrete for moisture content. Wait until wood is fully dry

after rain or morning fog or dew.

PRODUCT DATA SHEET 2 - Apply coatings using methods recommended by manufacturer.

PRODUCT DATA SHEET 3 - Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.

PRODUCT DATA SHEET 4 - Apply coatings at spreading rate required to achieve the manufacturers recommended dry film thickness.

PRODUCT DATA SHEET 5 - Regardless of number of coats specified, apply as many coats as necessary for complete hide, and uniform appearance.

PRODUCT DATA SHEET 6 - Inspection: The coated surface must be inspected and approved by the Architect just prior to the application of each coat.

SCHEDULE 3 - PROTECTION

PRODUCT DATA SHEET 0 - Protect finished coatings from damage until completion of project.

PRODUCT DATA SHEET 1 - Touch-up damaged coatings after substantial completion, following manufacturer's recommendation for touch up or repair of damaged coatings. Repair any defects that will hinder the performance of the coatings.

**END OF SECTION 099000**

**SECTION 122413**

**ROLLER WINDOW SHADES**

PART 1 - GENERAL

1.1 SECTION REQUIREMENTS

A. Submittals: Product Data and Samples.

PART 2 - PRODUCTS

2.1 ROLLER WINDOW SHADES

A. Manufacturers:

1. Hunter Douglas Contract.
2. Lutron Electronics Co., Inc.

B. Provide shadeband material passing flame-resistance testing according to NFPA 701.

C. Fabrication: Comply with WCMA A 100.1. Fabricate shadebands without battens or seams to extent possible except as follows:

1. Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length.

D. Motor Operated Roller Shades: Listed and labeled to comply with NFPA 70. Tubular, enclosed in roller.

1. Remote Control: Individual wall-switch-operated control station

E. Shadeband Materials:

1. Light-Filtering Fabric: [PVC-coated fiberglass] [PVC-coated polyester] [Woven PVC-coated fiberglass and PVC-coated polyester] [Woven polyester and PVC-coated polyester] [Acrylic-coated fiberglass] [PVC-coated fiberglass with silver backing] <Insert description>.
2. Light-Blocking Fabric: [Fiberglass textile with PVC film bonded to both sides] [Fiberglass with acrylic backing] [Acrylic-coated fiberglass] [Polyester-cotton blend] [Polyester with foamed-acrylic backing] [PVC-coated fiberglass with bonded PVC film] <Insert description>.
3. Roll Width: [36 inches (914 mm)] [48 inches (1229 mm)] [60 inches (1524 mm)] [72 inches (1829 mm)] [84 inches (2134 mm)] <Insert dimension>.
4. Openness Factor: [1] [3] [5] [10] [11] [22] <Insert number> percent.
5. Color: [As indicated on Drawings] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.

F. Installation Accessories:

1. Front fascia.
2. Exposed headbox.
3. Endcap covers.
4. Recessed shade pocket.
5. Closure panel and wall clip.
6. Side channels and bottom (sill) channel or angle with light seal.
7. Color and Finish: [As selected from manufacturer's full range] <Insert color and finish>.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's instructions.

1. Opaque Shadebands: Located so shadeband is not closer than [2 inches (51 mm)] <Insert dimension> to interior face of glass. Allow clearances for window operation hardware.

B. Adjust roller shades to operate smoothly and easily throughout entire operational range.

**END OF SECTION 122413**

# SECTION 220000 - BASIC MECHANICAL REQUIREMENTS – PLUMBING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 22.

REVIEW ALL SECTIONS OF DIVISION 1 TO ENSURE THAT REQUIREMENTS FOR MECHANICAL INSTALLATIONS ARE ADEQUATELY COVERED. REQUIREMENTS COVERED IN DIVISION 1 SHOULD NOT BE REPEATED IN THIS SECTION. THIS SECTION COVERS ONLY REQUIREMENTS PECULIAR TO DIVISION 15 AND COMMON TO MORE THAN ONE SECTION OF DIVISION 15. REFER TO EVALUATIONS AND SPEC COORD SHEETS FOR FURTHER DISCUSSION.

### 1.2 SUMMARY

A. This Section includes the requirements for the following:

1. Codes, organizations, standards, and abbreviations
2. Responsibility
3. Site Visit
4. Outages
5. Submittals
6. Variances
7. Performance requirements
8. Material and equipment
9. Coordination, sequencing and scheduling
10. Demolition
11. Fire safe materials
12. UL requirements
13. Coordination drawings
14. Construction record documents.
15. Operation and maintenance manuals
16. Fire stops and smoke seals
17. Warranty / Guarantee
18. Listed manufacturers
19. Approved equal equipment layouts
20. Concrete pump bases
21. Grout
22. Combination motor starters, VFD, and controllers – Plumbing equipment
23. General requirements - Execution
24. Existing Plumbing Systems
25. Equipment roughins
26. Mechanical installation - Plumbing
27. Cutting and patching
28. Cutting, welding and burning
29. Painting and finishing
30. Concrete bases

31. Erection of metal supports and anchorage
32. Demolition
33. Grout
34. Penetration of water proof construction
35. Excavation and backfilling
36. Cleaning and Finishes
37. Lintels
38. Electrical requirements
39. Provisions for access
40. Operation of equipment
41. Temporary service and equipment use
42. Demonstration and instructions
43. Lubrication
44. Wall and floor penetrations
45. Equipment provided under another division and by others
46. Construction record drawings
47. Closeout procedures
48. Clean up
49. Project punchout

1.3 CODES, ORGANIZATIONS, STANDARDS AND ABBRIVIATIONS

A. The following list of codes, organizations, standards and abbreviations are utilized within Division 22 Specification Sections and are provided as a reference.

B. Codes: All material and equipment provided and installed as part of these construction documents shall be in compliance with the latest edition of the following codes as adapted by the State for the following codes:

1. FBC: Florida Building Code
2. FMC: Florida Mechanical Code
3. FECC: Florida Energy Conservation Code
4. NEC: National Electrical Code
5. NFPA: National Fire Protection Association
6. PHCC: National Standard Plumbing Code Illustrated

C. Organizations and Standards: The list of organizations and standards are as follows:

1. ADA: American National Standards Institute
2. AGA: American Gas Association
3. ANSI: American National Standards Institute
4. ASHRAE: American Society of Heating Refrigeration and Air Conditioning Engineers
5. ASME: American Society of Mechanical Engineers
6. ASSE: American Society of Safety Engineers
7. ASTM: American Society for Testing and Materials
8. AWS: American Welding Society
9. AWWA: American Water Works Association
10. CDA: Copper Development Association Inc.
11. CFR; Code of Federal Regulations
12. CGA: Compressed Gas Association
13. CISPI: Cast Iron Soil Pipe Institute

14. CS: Commercial Standard
15. CSA: Canadian Standards Association
16. EJMA: Expansion Joint Manufacturers Association
17. EPA: Environmental Protection Agency
18. FDA: Food and Drug Administration
19. FSA: Fuel Sealing Association
20. IAPMO: International Association of Plumbing and Mechanical Officials
21. IBC: International Building Code
22. IBR: Institute of Boiler and Radiator Manufacturers
23. ICC: International Code Council
24. ICC-ES: International Conference on Computational & Experimental Engineering and Sciences
25. IEEE: Institute of Electrical and Electronics Engineers
26. ITT: International Telephone & Telegraph Corporation
27. LED: Light Emitting Diode
28. MFMA: Metal Framing Manufacturers Association
29. MIL: Military Standard
30. OSHA: Occupational Safety and Health Administration
31. MSS: Manufacturers Standardization Society
32. MSS SP: Manufacturers Standardization Society Standard Practice
33. NEMA: National Electrical Manufacturers Association
34. NEMA MG: National Electrical Manufacturers Association Motors & Generators
35. NFPA: National Fire Protection Association
36. NICET: National Institute for Certification in Engineering Technologies
37. NSF: National Sanitation Foundation
38. NRTL: Nationally Recognized Testing Laboratory
39. OSHA: Occupational Safety and Health Administration
40. OSHPD: Office of Statewide Health Planning and Development
41. PDI: Plumbing and Drainage Institute
42. SE: Safety Engineering
43. SEI: Software Engineering Institute
44. SSPC: Society for Protective Coatings
45. UL: Underwriters' Laboratories
46. USP - NF: The United States Pharmacopeia and The National Formulary

D. Abbreviations: The list of abbreviations are as follows:

1. AEC: Architecture, Engineering and Construction
2. ASJ: All Service Jacket
3. AWF: All Weather Finish
4. AWG: American Wire Gauge
5. CAD: Computer Aided Design
6. CD-ROM: Compact Disk – Read Only Material
7. CM: Construction Manager
8. CWP: Cold Working Pressure
9. ºC: Degree Celsius
10. ºF: Degree Fahrenheit
11. Dwg: Drawing
12. DOC: Document
13. Dwg: Drawing
14. EPDM: Ethylene Propylene Diene Terpolymer Rubber

15. FNPT: Female National Pipe Thread
16. FSK: Foil-Scrim-Kraft
17. FT: Foot, Feet
18. GC: Glass Cloth
19. g/L: Gram per Liter
20. GPH: Gallons per Hour
21. HCFC: Hydrochlorofluorocarbons
22. HNBR: Hydrogenated Nitrile Butadiene Rubber
23. HP: Horse Power
24. HVAC: Heating Ventilation and Air Conditioning
25. Hz: Hertz
26. ID: Inside Diameter
27. IEQ: Indoor Environmental Quality
28. IN: Inches
29. kPa: Kilopascal
30. Lb/ft: Pound-Foot
31. LED: Light Emitting Diode
32. LF: Linear Feet
33. LLDPE: Linear Low Density Polyethylene Resins
34. MAX: Maximum
35. MER: Mechanical Equipment Room
36. MIN: Minimum
37. mPa: Megapascal
38. N/A: Not Applicable
39. NBR: Acrylonitrile-Butadiene, Buna-N, or Nitrile Rubber
40. NOM: Nominal
41. NON: Not In
42. NPS: Nominal Pipe Size
43. NPT: National Pipe Thread
44. NRS: Nonrising Stem
45. OD: Outside Diameter
46. OS&Y: Outside Screw and Yoke
47. OXY: Oxygen
48. Pdf: Portable Document Format
49. PE: Polyethylene
50. PSI: Pounds per Square Inch
51. PSIG: Pounds per Square Inch Gage
52. PVC: Polyvinyl Chloride
53. RO/DI: Reverse Osmosis/Distilled Water
54. RS: Rising Stem
55. SWP: Steam Working Pressure
56. UV: Ultraviolet
57. V: Volt
58. VAC: Vacuum
59. VOC: Volatile organic compounds

## 1.4 RESPONSIBILITY

A. The Construction Manager/General Contractor (CM/GC) shall be responsible for all work included in Division 22. The delegation of work to the contractors shall not relieve him of this responsibility. Contractors who perform work under this Division shall be responsible to the CM/GC.

## 1.5 SITE VISIT

A. Prior to preparing the bid, the mechanical plumbing subcontractor shall visit the site and become familiar with all existing conditions. Make all necessary investigations as to locations of utilities and all other matters which can affect the work. No additional compensation will be made to the contractor as a result of his failure to familiarize himself with the existing conditions under which the work must be performed.

## 1.6 OUTAGES

A. For all work requiring an outage, the fire protection contractor shall submit an outage request to the Owner Project Manager. The existing fire protection systems shall remain operational unless turned off by Owner personnel during the construction of the project.

B. Unless otherwise specified, outages of any services required for the performance of this contract and affecting areas other than the immediate work area shall be scheduled at least ten business days (10) days in advance with the Owner. Outages shall be performed during normal duty hours. If necessary some outage work may be performed outside normal hours if approved by the Owner.

C. All plumbing outages which will interfere with the normal use of the building in any manner shall be done at such times as shall be mutually agreed upon by the contractor and the Owner.

D. The plumbing contractor shall include in his price the cost of all premium time required for outages and other work which interferes with the normal use of the building, which will be performed, in most cases, during other than normal work time and at the convenience of the Owner.

E. The operation of plumbing valves or switches; required to achieve an outage must be operated by Owner personnel only. Unauthorized operation of HVAC valves, power switches, by contractors and their personnel will result in extremely serious consequences for which the contractor will be held accountable.

## 1.7 SUBMITTALS

A. General: For general requirements see Architectural Specification Division 01 Section "Submittals".

B. CHANGE THE NUMBER OF ADDITIONAL COPIES INDICATED BELOW TO SUIT OFFICE PRACProvide submittals for all material, equipment and/or supports as specified in Division 22 and where indicated on the drawings and details. For material and CHANGE THE NUMBER OF ADDITIONAL COPIES INDICATED BELOW TO SUIT OFFICE PRACproduct data submission requirements see Division 22 Specification Sections. At a minimum the following submittals shall be provided as required by the project:

1. Pipe, fittings and accessories for each system.
2. Valves, strainers and unions for each system.
3. Insulation.
4. Hangers and supports.
5. Plumbing fixtures and trim.
6. Identification labels and tags.
7. Floor drains.
8. Roof drains.

9. Hot water heating equipment.
10. Trap priming system.
11. Backflow preventers.
12. Plumbing pumps.
13. Pipe and equipment roof curbs and supports.
14. Coordination drawings.

C. Submittal File Format: File formats for each submittal shall be electronically as follows:

1. Product Data: “pdf” file format.
2. Shop Drawings: “pdf” file format.
3. Coordinated Drawings: “pdf” or “dwg” file formats.
4. Schedules: “xl” file format.

## 1.8 VARIANCES

A. Where variances occur between the drawings and specifications or within either document itself, the item or arrangement of better quality, greater quantity or higher cost shall be included in the contract price. The Engineer shall decide on the item and manner in which the work shall be provided.

## 1.9 PERFORMANCE REQUIREMENTS

A. Contract drawings are generally diagrammatic and do not indicate all offsets, fittings, transitions, access panels and other specialties required. Furnish and install all items as may be required to fit the work to the conditions encountered.

B. Arrange plumbing piping, equipment and other work generally as shown on the contract drawings, providing proper clearances and access.

C. Where departures are proposed because of field conditions or other causes, prepare and submit detailed shop drawing submittal for approval in accordance with Submittals specified below.

D. The Architect may make reasonable changes in location of equipment piping and ductwork up to the time of rough-in or fabrication.

## 1.10 MATERIALS AND EQUIPMENT

A. The contract drawings and system performances have been designed on the basis of using the particular manufacturer’s products specified or scheduled on the contract drawings.

B. Products of other manufacturer’s listed in the specification shall be permitted provided as follows:

1. Products meet all of the requirements of the specifications.
2. Make, without additional cost to the Owner, all adjustments for deviations, such that the final installation is complete and functions as the basis of design product is intended.

C. Products with dimensions or other characteristics different from the basis of design product that render their use impractical or cause functional fit, access, or connection problems, shall not be acceptable.

## 1.11 COORDINATION, SEQUENCING AND SCHEDULING

REVISE ITEMS IN THE FOLLOWING EXAMPLES TO COVER PROJECT REQUIREMENTS.

A. Coordination: Coordinate plumbing systems, equipment, and materials installation with other building components.
B. Utilities: Coordinate connection of plumbing systems with exterior underground services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

C. Chases: Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

D. Sleeves: Coordinate the installation of required supporting devices and set sleeves in poured in place concrete and other structural components as they are constructed.

E. Sequencing: Sequence, coordinate, and integrate installations of plumbing material and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.

F. Electrical Services: Coordinate connection of electrical services.

G. Access: Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Architectural Specification Section "Access Doors."

H. Scheduling: Schedule and coordinate the delivery of material and equipment with other trades to avoid delivery conflicts.

1.12 FIRE SAFE MATERIALS

A. Unless otherwise indicated, materials shall conform to UL, NFPA or ASTM standards for fire safety with smoke and fire hazard rating not exceeding flame spread of twenty-five (25) and smoke development of fifty (50).

1.13 UNDERWRITER'S LABORATORY (UL) REQUIREMENTS

A. All equipment containing electrical components and provided as part of the mechanical specifications shall bear the Underwriter's Laboratory (UL) label, as a complete packaged system.

1. Equipment not provided with a UL label shall be tested in the field, certified and provided with a UL label at the installer's expense.
2. Field testing shall be performed by a testing agency approved by the authority having jurisdiction.

REFER TO DIVISION 1 SECTION "PROJECT COORDINATION," TEXT AND EVALUATIONS, FOR GENERAL REQUIREMENTS BEFORE EDITING THIS ARTICLE. SPECIFY ONLY MECHANICAL-RELATED REQUIREMENTS HERE.

1.14 COORDINATION DRAWINGS

REVISE THE FOLLOWING EXAMPLES TO INCLUDE SPECIFIC ROOMS, RESTRICTED SPACE LOCATIONS, EQUIPMENT INSTALLATIONS, SYSTEM INTERFACES, AND SIMILAR CRITICAL WORK (ACTUAL PROJECT CONDITIONS).

A. General: When required participate in the preparation of the coordinated drawing effort for the project. See Specification Division 01 for general requirements.

B. Coordination Drawings: In addition to the requirements of the Specification Division 01 prepare the plumbing part for the coordination drawing effort. Work with the other trades to ensure the material and equipment installed as part on the plumbing system will not be in conflict with the installation of material and equipment by the other trade contractors. Unless otherwise indicated the coordination drawings, including plans, sections, and elevations shall be prepared at a scale of not less than 1/4 inch = 1 foot- 0 inches. At a minimum, prepare coordination drawings for all mechanical rooms, electrical rooms and substation rooms.

C. File Format: Coordination drawings shall be in a layered structure form as CAD Files or PDF Files for each floor with searchable text as follows:

1. File Structure: The “pdf” or “dwg” files shall have separate layered structure for:

a. Building Elements: Indicate each building element on separate layers, such as:

1) Walls.
2) Reflected ceiling plan.
3) Room numbers.

b. Systems and Sub Systems: Indicate each system or sub system as warranted by congestion or complexity on separate layers such as:

1) Examples of Systems:
   a) Domestic Water System.
   b) Sanitary Waste System.

2) Examples of Sub Systems:
   a) Domestic Cold Water System.
   b) Domestic Hot Water System.

2. The layered electronic files shall allow building elements, building systems and sub systems to be viewed in isolation or in combinations that are user selectable when the drawing files are being displayed.

D. Coordination Effort: This coordination effort shall include detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of plumbing system piping, valves, equipment, and materials. Include the following:

a. Clearances for servicing and maintaining equipment, including, the space for equipment disassembly required for periodic maintenance.
b. Exterior wall and foundation penetrations.
c. Sizes and location of required concrete pads and bases.

d. Size and location of pipe hangers and other components for pipe supports.
e. All plumbing system roughins for equipment and fixtures.
f. Access doors.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations. Show all wall mounted access doors for mechanical devices.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, cable trays, sprinklers, access doors and other ceiling mounted items.

REFER TO DIVISION 1 SECTIONS "FIELD ENGINEERING" AND "PROJECT CLOSEOUT," TEXT AND EVALUATIONS, FOR GENERAL REQUIREMENTS BEFORE EDITING THIS ARTICLE. SPECIFY ONLY MECHANICAL-RELATED REQUIREMENTS HERE.

1.2 CONSTRUCTION RECORD DOCUMENTS

A. The mechanical/plumbing contractor shall maintain a set of construction record documents during the construction period in accordance with Specification Division 01 Section “Project Closeout”.
REFER TO DIVISION 1 SECTION "PROJECT CLOSEOUT," TEXT AND EVALUATIONS, FOR GENERAL REQUIREMENTS BEFORE EDITING THIS ARTICLE. SPECIFY ONLY MECHANICAL-RELATED REQUIREMENTS HERE.

1.3 OPERATION AND MAINTENANCE MANUALS

A. Prepare one (1) electronic maintenance manual file in “pdf” format in accordance with Specification Division 01 Section "Project Closeout."
REFER TO DIVISION 1 SECTION "MATERIALS AND EQUIPMENT," TEXT AND EVALUATIONS, FOR GENERAL REQUIREMENTS BEFORE EDITING THIS ARTICLE. SPECIFY ONLY MECHANICAL-RELATED REQUIREMENTS HERE.

1.4 FIRE STOPS & SMOKE SEALS

A. Provide fire stops and smoke seals for all mechanical services installed and existing services in the project area that pass through fire rated partitions, wall, floors etc. Services shall include all ductwork, conduit, metal and plastic piping, cables, etc. The area around penetrations including any voids between them must be filled in and sealed with UL fire rated materials equal to the adjoining materials. All fire stop insulation devices and sealants shall maintain the fire resistance integrity of the floor, wall partition, etc. and meet ASTM 814-83 F&T rating for time, hours and temperature rise. All fire stopping and sealants shall allow for expansion and contraction movement without pumping free of openings. Provide UL System Numbers in product submittals for each Fire Stop & Smoke Seal Application.

B. The installer of firestop and smoke seal materials shall be a firm licensed or otherwise approved by the manufacturer of the materials and have at least five (5) years experience installing firestop and smoke seal materials. Installer shall comply with the material manufacturer's recommendations and installation requirements and ASTM and applicable code requirements.

C. All fire stop and smoke seal materials shall be as manufactured by any one of the following manufacturers:

1. Specified Technologies Inc. (STI)
2. DOW Corning Corp.
3. 3M Inc.
4. Hilti

REFER TO DIVISION 1 SECTION "MATERIALS AND EQUIPMENT," TEXT AND EVALUATIONS, FOR GENERAL REQUIREMENTS BEFORE EDITING THIS ARTICLE. SPECIFY ONLY MECHANICAL-RELATED REQUIREMENTS

1.5 WARRANTY/GUARANTEE

A. All materials, equipment, etc. provided by the general contractor and/or his subcontractors shall be warranted and guaranteed to be free from defects in workmanship and materials for a period of two (2) years from the date of substantial completion and acceptance of work by the Owner. Any defects in workmanship, materials, or performance which appear within the guarantee period shall be corrected by the contractor without cost to the owner, within a reasonable time, to be specified by the Owner. In default thereof, owner may have such work done and charge the cost of same to the contractor. In addition to the above statement the Warranty/Guarantee Period shall include also all labor cost related to all warranty work. For compressorized equipment include an additional three (3) year Warranty/Guarantee Period.

**PART 2 - PRODUCTS**

2.1 LISTED MANUFACTURERS:

A. Listed Manufacturers: The listed manufacturers indicated in Part 2 of each specification section as the basis of design represents the minimum level of quality for materials and equipment that is acceptable to the Owner. Unless otherwise indicated in each specification section, contractors may submit material and equipment by non listed manufacturers provided said submittals meet all of the requirements of these specifications. All submitted materials and equipment are subject to approval by the A/E and the Owner.

2.2 APPROVED EQUAL EQUIPMENT LAYOUTS

B. Approved Equal Equipment Layouts: The equipment layouts and the related mechanical and electrical service connections, access space and supports indicated on the construction documents represent equipment provided by the specified basis of design manufacturer and model number. When the successful bidder chooses to provide “or approved equal” equipment by one (1) of the other listed manufacturers in the specifications, the bidder shall be responsible for providing all adjustments and modifications to the services necessary to make connections to the equipment, the bidder shall be responsible for installing the equipment such that all required clear access space is maintained, and the bidder shall be responsible for providing all adjustments and modifications to the equipment mounting and supports. All adjustments and modifications shall be provided by the bidder and appropriate subcontractors at no additional cost to the project.

2.3 CONCRETE PUMP BASES

A. Concrete: 3,500 psi compressive strength after twenty eight (28) days.

B. Grout shall be non-shrink, high strength type, free of iron or chlorides and suitable for use in contact with all metals, without caps or other protective finishes.

2.4 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post hardening, volume adjusting, dry, hydraulic cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5,000 psi (34.50MPa), twenty eight (28) day compressive strength.
3. Packaging: Premixed and factory packaged.

2.5 COMBINATION MOTOR STARTERS, VFD'S AND CONTROLLERS – PLUMBING EQUIPMENT

A. Combination motor starters, VFD's and/or controllers shall be provided for all motors serving plumbing equipment as follows:

1. Skid Mounted Equipment: Combination motor starters, VFD's and/or controllers shall be provided by the equipment manufacturer as part of Division 22.
2. Non Skid Mounted Equipment: Combination motor starters, VFD's and/or controllers shall be provided as part of Division 26.

**PART 3 – EXECUTION**

3.1 GENERAL REQUIREMENTS – EXECUTION

A. All construction work that creates excessive noise will not be permitted during normal business hours. See Division 01 Specification Section 01045 "Cutting and Patching" for requirements.

3.2 EQUIPMENT ROUGH IN AND FINAL CONNECTIONS

A. Locations: Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Rough in Requirements: Refer to equipment specifications included in the architectural, mechanical, and electrical specifications for equipment rough in requirements. Provide final connections for each piece of equipment.

C. Owner Furnished Equipment: Refer to owner supplies equipment specifications and/or cut sheets for equipment rough in requirements. Provide final connections for each piece of owner supplied equipment.

3.3 MECHANICAL INSTALLATIONS - PLUMBING

A. Verify all dimensions by field measurements.

B. Where plumbing systems, materials and equipment are intended for overhead installation, and where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible. Notify Owner - PM prior to installation of plumbing system components when headroom is less than 7'-6" and/or where existing system components will be below the new finished ceiling height. Notification shall be through the "RFI" process.

C. Install plumbing systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by

the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, identify the conflict and submit and “RFI” for each conflict to the Architect.

D. Install plumbing systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.

E. REFER TO DRAWING COORDINATION CHECKLIST.Install plumbing equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

F. Install access panel or doors where material and/or equipment requiring service will be concealed behind finished surfaces. Access panels and doors are specified in the architectural specifications.

G. Install plumbing systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

H. The contractor shall confirm that all pressure vessels are installed in full compliance with the requirements of the Sate Inspector’s Office for Boilers and Pressure Vessels. Refer to “Closeout Procedures” in this Section for additional requirements.

REFER TO DIVISION 1 SECTION "CUTTING AND PATCHING," TEXT AND EVALUATIONS, FOR GENERAL REQUIREMENTS BEFORE EDITING THIS ARTICLE. SPECIFY ONLY MECHANICAL-RELATED REQUIREMENTS HERE.

3.4 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Specification Section "Cutting and Patching" In addition to the requirements specified in Specification Division 01, the following requirements apply:

1. Patch Materials: Patch finished surfaces and building components using new materials specified for the original installation and using experienced Installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

B. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, ductwork, plumbing fixtures and trim, and other mechanical items made obsolete by the new work.

3.5 CUTTING, WELDING, BURNING

A. Before the contractor and/or any sub-contractor commences any cutting, welding, burning, brazing (pipe sweating), the contractor shall obtain a hot work permit from the Fire Marshal.

B. The hot work permit copy shall remain on the job site at the hot work location until such work is completed at which time the permit shall be returned to the Fire Marshal.

3.6 PAINTING

A. Refer to Architectural Specification Section "Painting" for field painting requirements.

B. Damage and Touch Up: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Do not paint manufacturer's labels or tags.

3.7 CONCRETE BASES

COORDINATE CONCRETE WORK WITH DIVISION 3.

A. Construct concrete equipment bases of dimensions indicated, but not less than four (4) inches (100 mm) larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3,000 psi (20.70MPa), twenty eight (28) day compressive strength concrete and reinforcement bars as specified in the architectural specifications.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.9 GROUTING

A. Install nonmetallic nonshrink grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

3.10 PENETRATION OF WATERPROOF CONSTRUCTION

A. Coordinate the work to minimize penetration of waterproof construction, including roofs, exterior walls and interior waterproof construction.

B. Furnish and install drains, curbs, vent assemblies, sleeves, flashing, etc. specifically designed for application to the particular construction. Install system in accordance with the roofing manufacturer's instructions.

3.11 EXCAVATION AND BACKFILLING

A. General: Perform all necessary excavation and backfilling necessary for the installation of underground plumbing services as part of Division 22 in accordance with the architectural specifications.

3.12 CLEANING AND FINISHES

A. Clean surfaces prior to application of insulation, adhesives, coating, and paint.

B. Provide factory applied finish where specified.

C. Protect all finishes, and restore all finishes to their original condition if damaged as a result of work installed as part of the mechanical specifications.

D. Remove all construction marking and writing from exposed equipment, piping and building surfaces.

3.13 LINTELS

A. Lintels shall be provided for openings in masonry, brick, concrete, etc. walls to accommodate work of this division.

1. Lintels shall be provided under this division when not being provided under other divisions. Lintels shall be approved by the Architect.

3.14 ELECTRICAL REQUIREMENTS

A. Unless otherwise indicated, furnish and install control and interlock wiring for the equipment furnished under this division. In general, power wiring and motor starting equipment will be provided as specified in the electrical specifications.

1. Where the electrical requirements of the equipment furnished differ from the provisions made in the electrical specifications, make the necessary allowances as part of the mechanical specifications.
2. Where no electrical provisions are included in the electrical specifications, include all necessary electrical work as part of the mechanical specifications.

B. All electrical work performed as part of the mechanical specifications shall be provided in accordance with the electrical specifications.

3.15 PROVISIONS FOR ACCESS

A. Furnish and install adequate access to all plumbing components. The following list shall be used as a guide only:

1. Equipment
2. Valves
3. Cleanouts
4. Traps
5. Low point drains

B. Access shall be adequate as determined by the Architect.

C. Refer to contract drawings where access panels have been specifically located.

D. Where access is by means of lift out ceiling tiles or panels mark each access panel using small color coded or numbered tabs. Provide an index chart for identification. Place markers in corner of tile.

3.16 OPERATION OF EQUIPMENT

A. Clean all systems and equipment prior to initial operation for testing and balancing.

B. Do not operate equipment unless all proper safety devices or controls are operational.

C. Provide all maintenance and service for equipment which is operated during construction.

D. Where specified and otherwise required, provide the services of a manufacturer's factory trained service organization to start the equipment.

3.17 TEMPORARY SERVICE AND EQUIPMENT USE

A. Temporary Service: Unless temporary services are required as part of the project, do not use plumbing systems for temporary services during construction unless authorized in writing by the Architect and/or the Owner.

B. Equipment Use: Where such authorization is granted, temporary use of new and or existing equipment shall not limit or otherwise affect warranties or guarantees covering new equipment. Where equipment is used by the contractor the contractor shall perform all required preventive maintenance on the equipment during the construction period. Upon completion of work, clean and restore all new and/or existing equipment to new condition and replace all filters as necessary.

3.18 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of equipment and systems to Owner’s personnel a minimum two (2) weeks prior to date of final inspection.

1. For equipment requiring seasonal operation, perform instructions for other seasons at the same time.
2. Training period shall be performed within one (1), two (2) week period.

B. Use operation and maintenance manuals and video as basis of instruction. Review contents of manual and video with personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate the following:

1. Start up.
2. Operation.
3. Control.
4. Adjustment.
5. Trouble shooting.
6. Servicing.
7. Maintenance.
8. Shutdown.

D. Provide at least forty (40) hours straight time instruction to the operating personnel.

1. This instruction period shall consist of not less than five (5) eight (8) hour days.
2. Time of instruction shall be designated by the Owner.
3. This instruction shall be in addition to instructional requirements of specific equipment specified elsewhere in the mechanical specifications.

3.19 LUBRICATION

A. All bearings, motors and all equipment requiring lubrication shall be provided with accessible fittings.

B. Before turning over the equipment to the Owner, the Installer shall provide the following:

1. Fully lubricate each item of equipment.
2. Provide one (1) year's supply of lubricant for each type of lubricant.
3. Provide complete written lubricating instructions, together with diagram locating the points requiring lubrication.

C. Motors and equipment shall be provided with grease lubricated roller or ball bearings with Alemite or equal extended grease fittings and drain plugs.

3.20 WALL AND FLOOR PENETRATIONS

A. All penetrations of partitions, walls and floors by ducts, piping or conduit under Specification Division 22 shall be sealed and caulked. Provide UL listed fire stopping systems at penetrations through fire walls as specified in the architectural specifications.

3.21 EQUIPMENT PROVIDED UNDER ANOTHER DIVISION AND BY OTHERS

A. The Installer of products under Division 22 shall make all system connections required to equipment furnished and installed under another division and by others.

B. It shall be the responsibility of the Installer to obtain all necessary data from the equipment supplied under other Divisions.

3.22 CONSTRUCTION RECORD DRAWINGS

A. As the work progresses, the contractor shall record on one (1) set of prints, the installed locations, sizes, and depths of pipes, services, equipment, etc. which may differ from the approved contract drawings.

B. Upon completion of the plumbing system installations, the plumbing contractor shall deliver to the construction manager one (1) complete set of the plumbing system marked-up blueprints of the plumbing contract drawings.

1. The mark-ups shall be legibly marked in red pencil to show all changes and departures of the installation as compared with the original design.

C. At a minimum include the following installed conditions:

1. Location of all shut off valves, drain valves, and balancing valves with assigned valve tag numbers.
2. Show the location of concealed material and/or equipment requiring service such as strainers, traps, hot water heaters, and/or expansion compensators.
3. Actual entering/leaving invert elevations for domestic water, sanitary, storm water, and natural gas services for the building.
4. Where building services are located below floor slabs show the actual low point invert elevation and the high point invert elevation for gravity piping systems.

3.23 CLOSEOUT PROCEDURES

A. Operating and Maintenance Instructions: Submit a complete package at least one (1) month prior to substantial completion. Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Maintenance manuals, including a customized list of preventive maintenance items and annual schedule for maintenance.
2. Record documents.
3. Complete inventory of spare parts and materials.
4. Tools.
5. Lubricants.
6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. As part of instruction for operating equipment, demonstrate the following procedures:

1. Start up.
2. Shut down.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

C. Pressure Vessel Inspections by the State: For the purpose of obtaining and having buildings insured by any commercial insurance carrier, the contractor shall arrange for the inspection of all pressure vessels installed during construction. The contractor shall contact the Office of Boiler and Pressure Vessel Inspections of the Department of Labor, Licensing and Regulations (DLLR), State, and arrange for the inspections. The DLLR shall be notified at least thirty (30) days prior to installation. After such inspections are carried out by the State Inspector’s office, Certificates of Compliance will be issued to the contractor of record to be turned over to the Owner’s representative for compliance with current insurance regulations as part of the Project Documents. Examples of pressure vessels include boilers, heat exchangers, converters, expansion tanks, water heaters, hot water generators and storage tanks. Chillers are excluded and are covered under ASHRAE Guidelines.

3.24 CLEAN UP

A. Excessive debris and dirt, such as occurs from cutting through masonry or plaster walls shall be cleaned up from the equipment and removed immediately after the work of cutting through the walls.

B. Debris shall be removed from Owner's property.

C. Ceiling panels shall be replaced as soon as work is finished in the area, and shall be kept free of dirty finger prints. Where work is being done in corridors used by patients and ceiling panels shall be replaced at the close of the day's work even if work is at the particular location is incomplete.

D. All areas shall be left broom-clean at the end of the work period.

E. Remove all mechanical clipping, wiring, nuts, bolts, etc. left on top of ceilings and ceiling tiles.

3.25 PROJECT PUNCH OUT

A. Architect/Engineer will perform punch out reviews and will provide the Contractor with a list of punch list items to be completed before contract close out. Each and every punch list item shall be initialed and dated by the Contractor when the work is complete. The Architect/ Engineer will not perform any punch list verification until all items have been completed, initialed, dated and the list returned to the Architect/Engineer. If any items have been initialed as being completed by the Contractor and the Architect/Engineer determines that the work is not complete, the Architect/Engineer shall be reimbursed by the Contractor at his regular hourly rate for any and all items requiring revisiting of the site by the Architect/Engineer. Reimbursement shall be made by deducting the Architect/Engineer fee from the Contractor's final payment.

END OF SECTION 220000

# 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.
4. Silicone sealants.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 SLEEVES

A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, with plain ends and integral welded waterstop collar.

C. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

### 2.2 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig (137 kPa) minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.4 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) 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.

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."

## 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

## 3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. 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.

C. Prepare test and inspection reports.

## 3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than 6”: Cast-iron pipe sleeves.
b. Piping 6” and Larger: Cast-iron pipe sleeves

2. Exterior Concrete Walls below Grade:

    a. Piping Smaller Than 6”: Cast-iron pipe sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping 6” and Larger: Cast-iron pipe sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

    a. Piping Smaller Than 6”: Cast-iron pipe sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping 6” and Larger: Cast-iron pipe sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

    a. Piping Smaller Than 6”: PVC pipe sleeves.
    b. Piping 6” and Larger: PVC pipe sleeves.

5. Interior Partitions:

    a. Piping Smaller Than 6”: PVC pipe sleeves.
    b. Piping 6” and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 22 05 17

# SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

## PART 2 - PRODUCTS

### 2.1 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

D. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

### 2.2 FLOOR PLATES

A. Split Floor Plates: Cast brass with concealed hinge.

## 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 insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping and Relocated Existing Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
d. Insulated Piping: One-piece stamped steel with concealed hinge with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
f. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
h. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel [or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

2. Escutcheons for Existing Piping to Remain:

a. Chrome-Plated Piping: Split-casting, stamped steel with concealed hinge with polished, chrome-plated finish.
b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping and Relocated Existing Piping: Split floor plate.
2. Existing Piping: Split floor plate.

## 3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

# SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Steel ball valves.
4. Iron ball valves.

### 1.2 DEFINITIONS

A. CWP: Cold working pressure.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 6.

### 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 soldered ends.
3. Set ball 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.

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 B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 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 Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. 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. One-Piece, Brass Ball Valves:

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

a. Kitz Corporation.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig
c. Body Design: One piece.

d. Body Material: Forged brass or bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass or stainless steel.
h. Ball: Chrome-plated brass or stainless steel.
i. Port: Reduced.

B. Two-Piece, Brass Ball Valves with Full Port and Brass Trim:

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

a. American Valve, Inc.
b. Conbraco Industries, Inc.; Apollo Valves.
c. Crane Co.; Crane Valve Group; Crane Valves.
d. Crane Co.; Crane Valve Group; Stockham Valves.
e. DynaQuip Controls.
f. Hammond Valve.
g. Jomar International, LTD.
h. Kitz Corporation.
i. Legend Valve.
j. Marwin Valve; a division of Richards Industries.
k. Milwaukee Valve Company.
l. NIBCO INC.
m. Red-White Valve Corporation.
n. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

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.

C. Two-Piece, Brass Ball Valves with Full Port and Stainless-Steel Trim:

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

a. Kitz Corporation.
b. Marwin Valve; a division of Richards Industries.
c. Milwaukee Valve Company.

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: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

D. Two-Piece, Brass Ball Valves with Regular Port and Brass Trim:

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

a. Hammond Valve.
b. Legend Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

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.

E. Two-Piece, Brass Ball Valves with Regular Port and Stainless-Steel Trim:

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

a. Jamesbury; a subsidiary of Metso Automation.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Brass or bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

F. Three-Piece, Brass Ball Valves with Full Port and Brass Trim:

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

a. Jomar International, LTD.
b. Kitz Corporation.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three 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.

G. Three-Piece, Brass Ball Valves with Full Port and Stainless-Steel Trim:

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

a. Marwin Valve; a division of Richards Industries.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

## 2.3 BRONZE BALL VALVES

A. One-Piece, Bronze Ball Valves with Bronze Trim:

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

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 400 psig.
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Reduced.

B. One-Piece, Bronze Ball Valves with Stainless-Steel Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. NIBCO INC.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig
c. Body Design: One piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Reduced.

C. Two-Piece, Bronze Ball Valves with Full Port, and Bronze or Brass Trim:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 850XL (Lead Free) or comparable product by one of the following:

a. Milwaukee Valve Company.
b. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

D. Two-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Lance Valves; a division of Advanced Thermal Systems, Inc.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig (4140 kPa).
c. Body Design: Two piece.

d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

E. Two-Piece, Bronze Ball Valves with Regular Port and Bronze or Brass Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. DynaQuip Controls.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Regular.

F. Two-Piece, Bronze Ball Valves with Regular Port and Stainless-Steel Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Stockham Valves.
c. Hammond Valve.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig
c. Body Design: Two piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

G. Three-Piece, Bronze Ball Valves with Full Port and Bronze or Brass Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. DynaQuip Controls.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Red-White Valve Corporation.
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

H. Three-Piece, Bronze Ball Valves with Full Port and Stainless-Steel Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

I. Three-Piece, Bronze Ball Valves with Regular Port and Bronze Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Jamesbury, Inc.; a subsidiary of Metso Automation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece
d. Body Material: Bronze
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Bronze.
h. Ball: Chrome-plated brass.
i. Port: Regular.

J. Three-Piece, Bronze Ball Valves with Regular Port and Stainless-Steel Trim:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Jamesbury, Inc.; a subsidiary of Metso Automation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded or soldered.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

K. Two-Piece, Safety-Exhaust, Bronze Ball Valves:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Jamesbury, Inc.; a subsidiary of Metso Automation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Two piece.
d. Body Material: Bronze, ASTM B 584, Alloy C844.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Chrome-plated brass, with exhaust vent opening for pneumatic applications.
i. Port: Full.

2.4 STEEL BALL VALVES

A. Class 150, Steel Ball Valves with Full Port:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Jamesbury, Inc.; a subsidiary of Metso Automation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 285 psig.
c. Body Design: Split body.
d. Body Material: Carbon steel, ASTM A 216, Type WCB.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

B. Class 150, Steel Ball Valves with Regular Port:

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

a. Conbraco Industries, Inc.; Apollo Valves.
b. Jamesbury, Inc.; a subsidiary of Metso Automation.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 285 psig.
c. Body Design: Uni-body.
d. Body Material: Carbon steel, ASTM A 216, Type WCB.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Regular.

2.5 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model 850 or comparable product by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 200 psig.
c. Body Design: Split body.
d. Body Material: ASTM A 126, gray iron.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel.
i. Port: Full.

## 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 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 valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

### 3.3 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.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

## 3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Bronze and brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.
3. One piece, bronze ball valve with bronze or stainless-steel trim.
4. Two-piece, brass ball valves with full port and brass or stainless-steel trim.
5. Two-piece, bronze ball valves with full port and bronze, bass, or stainless-steel trim.
6. Three-piece, brass ball valves with full port and brass or stainless-steel trim.
7. Three-piece, bronze ball valves with full port and bronze, bass, or stainless-steel trim.
8. Two-piece, bronze ball valves with regular port and bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Class 150, steel ball valves with full port.
3. Class 150, iron ball valves.

## 3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG)

A. Pipe NPS 2 and Smaller:

1. Bronze and brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.
3. One piece, bronze ball valve with bronze or stainless-steel trim.
4. Two-piece, brass ball valves with full port and brass or stainless-steel trim.
5. Two-piece, bronze ball valves with full port and bronze, brass or stainless-steel trim.
6. Three-piece, brass ball valves with full port and brass or stainless-steel trim.
7. Three-piece, bronze ball valves with full port and bronze, brass or stainless-steel trim.
8. Two-piece, bronze ball valves with regular port and bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Class 150, steel ball valves with full port.
3. Class 150, iron ball valves.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. One piece, brass ball valve.
3. One piece, bronze ball valve with bronze or stainless-steel trim.
4. Two-piece, brass ball valves with full port and brass or stainless-steel trim.
5. Two-piece, bronze ball valves with full port and bronze, brass, or stainless-steel trim.
6. Three-piece, brass ball valves with full port and brass or stainless-steel trim.
7. Three-piece, bronze ball valves with full port and bronze, bass, or stainless-steel trim.
8. Two-piece, bronze ball valves with regular port and bronze or stainless-steel trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Class 150, steel ball valves with full port.
3. Class 150, iron ball valves.

END OF SECTION 220523.12

# SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Bronze lift check valves.
2. Bronze swing check valves.

### 1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61.

### 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, grooves, and weld ends.
3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 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 B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NSF Compliance: NSF 61 for valve materials for potable-water service.

E. 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.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Valves.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Class 125, Lift Check Valves with Nonmetallic Disc:

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

a. Flo Fab Inc.
b. Hammond Valve.
c. Kitz Corporation.
d. Milwaukee Valve Company.
e. Mueller Steam Specialty; a division of SPX Corporation.
f. NIBCO INC.
g. Red-White Valve Corporation.
h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig (1380 kPa).
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: NBR, PTFE.

## 2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze, Swing Check Valves with Bronze Disc:

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

a. American Valve, Inc.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Crane Co.; Crane Valve Group; Jenkins Valves.
d. Crane Co.; Crane Valve Group; Stockham Valves.
e. Hammond Valve.
f. Kitz Corporation.
g. The Macomb Groups.
h. Milwaukee Valve Company.
i. NIBCO INC.
j. Powell Valves.
k. Red-White Valve Corporation.
l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

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

a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Valves.
d. Hammond Valve.
e. Kitz Corporation.
f. Milwaukee Valve Company.
g. NIBCO INC.
h. Red-White Valve Corporation.
i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 4.
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: PTFE.

## 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 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

## 3.3 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.

## 3.4 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 or nonmetallic disc.
b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or spring; or iron, center-guided, metal-seat or resilient-seat check valves.
c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

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.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 and Larger: Flanged.
4. For Steel Piping, NPS 2 and Smaller: Threaded.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged or threaded.
6. For Steel Piping, NPS 5 and Larger: Flanged.
7. For Grooved-End Copper Tubing and Steel Piping: Grooved.

## 3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG OR LESS)

A. Pipe NPS 2 and Smaller:

1. Vertical, Upflow Applications Only: Bronze lift check valves, Class 125, bronze disc with soldered or threaded end connections.
2. Horizontal and Vertical Applications: Bronze swing check valves, Class 125 or Class 150, bronze disc with soldered or threaded end connections.

END OF SECTION 220523.14

# 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.
5. Pipe-positioning systems.
6. Equipment supports.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 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.

B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

## 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: 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-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-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.

2.3 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.
2. Outdoor Applications: Stainless steel.

2.4 PIPE-POSITIONING SYSTEMS

A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.6 MATERIALS

A. Aluminum: ASTM B221 (ASTM B221M).

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 (34.5-MPa), 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 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from 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. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) 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.

D. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

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. 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.

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. 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 (DN 100) 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 (DN 100) 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 (305 mm) long and 0.048 inch (1.22 mm) thick.
    b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
    c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
    d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
    e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) 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 of same thickness as piping insulation.

## 3.3 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.

## 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: 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.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting.", Section 099123 "Interior Painting."

C. 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 finishes.

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 metal trapeze pipe hangers and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant 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 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C) pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), 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 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
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 (DN 100 to DN 900), 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 (DN 100 to DN 900), 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 (DN 65 to DN 900) 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 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction occurs.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction occurs.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.

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 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) 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 of up to 6 inches (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) 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-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 (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

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. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.
b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-58 for trapeze pipe-hanger 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.

R. 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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

## PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, one eighth (1/8) inch thick, and having predrilled holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than two and one half (2-1/2) inches by three quarter (3/4) inches.
3. Minimum Letter Size: One quarter (1/4) inch for name of units if viewing distance is less than twenty four (24) inches, one half (1/2) inch for viewing distances up to seventy two (72) inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two thirds (2/3) to three fourths (3/4) the size of principal lettering.
4. Fasteners: Self tapping stainless steel screws, except contact type permanent adhesive where screws cannot or should not penetrate the substrate.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
6. Label Content: Include equipment's label as indicated on the construction documents.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving one eighth (1/8) inch thick, and having predrilled holes for attachment hardware.

B. Minimum Label Size: Length and width vary for required label content, but not less than two and one half (2-1/2) inch by three quarter (3/4) inch.

C. Minimum Letter Size: One quarter (1/4) inch for name of units if viewing distance is less than twenty four (24) inches, one half (1/2) inch for viewing distances up to seventy two (72) inches,

and proportionately larger lettering for greater viewing distances. Include secondary lettering two thirds (2/3) to three fourths (3/4) the size of principal lettering.

D. Fasteners: Self tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

E. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

F. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PLUMBING PIPE SYSTEM LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

1. Do not use pipe labels or plastic tapes for bare pipes conveying fluids at temperatures of 125°F (52°C) or higher

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

1. Small Pipes: For external diameters less than six (6) inches (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

a. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
b. Adhesive lap joint in pipe marker overlap.
c. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than three quarter (3/4) inch wide; full circle at both ends of pipe marker, tape lapped one and one half (1-1/2) inches.

2. Large Pipes: For external diameters of six (6) inches and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three (3) times letter height (and of required length), fastened by one of the following methods:

a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than one and one half (1-1/2) inches wide; full circle at both ends of pipe marker, tape lapped three (3) inches.
b. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Pipe label contents shall comply with the following:

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: At least one and one half (1-1/2) inches high.

## 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 LABEL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

E. Piping: Painting of piping is specified in Section 099123 "Interior Painting."

F. 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. 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 a 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.

G. On piping above removable acoustical ceilings. Omit intermediately spaced labelsPipe Label Color Schedule:

1. Domestic Water Piping

    a. Background: Safety green.
    b. Letter Colors: White.

2. Sanitary Waste and Storm Drainage Piping:

    a. Background Color: Safety black.
    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-water piping.
2. Domestic hot-water piping.
3. Domestic recirculating hot-water piping.
4. Domestic chilled-water piping for drinking fountains.
5. Roof drains and rainwater leaders.
6. Supplies and drains for handicap-accessible lavatories and sinks.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material test reports.

C. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

## PART 2 - PRODUCTS

### 2.1 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. Products that come into contact with stainless steel shall 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 shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials.

G. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.

1. Preformed Pipe Insulation: Type I, Grade A, with factory-applied ASJ.
2. 850 deg F (454 deg C).
3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

### 2.2 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 and Polyolefin Adhesive: Solvent-based adhesive.

1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
2. Wet Flash Point: Below 0 deg F (minus 18 deg C).
3. Service Temperature Range: 40 to 200 deg F (4 to plus 93 deg C).
4. Color: Black.

C. PVC Jacket Adhesive: Compatible with PVC jacket.

2.3 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Permanently flexible, elastomeric sealant.
2. Service Temperature Range: Minus 58 to plus 176 deg F.
3. Color: White or gray.

C. PVC Jacket Flashing Sealants:

1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
3. Color: White.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

**PART 3 - EXECUTION**

3.1 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils (0.127 mm) thick and an epoxy finish 5 mils (0.127 mm) thick if operating in a temperature range of between 140 and 300 deg F (60 and 149 deg C). Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. 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 of 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 storage, application, and finishing. Replace insulation materials that get wet.

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 attached to structure with vapor-barrier mastic.
3. Install insert materials and 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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 4 inches (100 mm) o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with 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 25 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 in similar fashion 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 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 (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

## 3.4 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, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation made from same material and density as that of 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 of same material and thickness as that 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 of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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 of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 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, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
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 and polyolefin, 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.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 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 (50 mm) 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 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 that of 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 that of 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.

## 3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

## 3.7 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 (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) 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 (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) 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 (25-mm) 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.

D. Where metal jackets are indicated, install with 2-inch (50-mm) 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 (300 mm) 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 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections.

D. Tests and Inspections: 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 of straight pipe, three locations of threaded fittings, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

E. All insulation applications will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

## 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. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:

1. Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

B. Stormwater and Overflow:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 thick.

C. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

D. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 thick.

END OF SECTION

# SECTION 220800 - COMMISSIONING PLUMBING SYSTEMS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 22.

B. The OPR and BOD documentation are included by reference for information only.

1.2 SUMMARY

A. This section includes the requirements for commissioning the plumbing systems, assemblies and equipment.

1.3 DESCRIPTION

A. The following equipment and/or accessories shall be commissioned as part of this project:

1. Domestic water booster pump
2. Domestic hot water heating equipment
3. Domestic hot water circulating pumps
4. Sump pumps

1.4 ACTION SUBMITTALS

A. Refer to Division 01 Specification Section “COMMISSIONING” for CxA’s role.

B. Refer to Division 01 Specification Section “SUBMITTAL PROCEDURES” for specific requirements.

C. Refer to Division 01 Specification Section “COMMISSIONING” for additional submittal requirements related to submittals of equipment to be commissioned and Cx specific submittals.

1.5 COORDINATION

A. Refer to Division 01 Specification Section “COMMISSIONING” for requirements pertaining to coordination during the commissioning process.

1.6 GENERAL DOCUMENTATION

A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems.

1.7 WARRANTY/GUARANTEE

A. See Division 22, Specification Section “Basic Mechanical Requirements – Plumbing” for warranty and guarantee requirements.

## PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. Refer to Division 01 Specification Section “COMMISSIONING” for requirements pertaining to testing equipment.

**PART 3 - EXECUTION**

3.1 TESTING PREPARATION

A. Certify in writing to the CxA that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Place systems, subsystems, and equipment into operating mode to be tested (e.g. for pumps, normal shutdown, normal auto position, normal manual position, emergency power, and alarm conditions).

C. Inspect and verify the position of each device and interlock identified on checklists.

D. Check safety cutouts, alarms, and interlocks during mode of operation.

E. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

C. The CxA along with the plumbing contractor shall prepare detailed testing plans, procedures, and checklists for applicable plumbing systems, subsystems, and equipment.

D. Tests will be performed using design conditions whenever possible.

3.3 PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Procedures: Where applicable follow manufacturer’s written procedures. If no procedures are prescribed by the manufacturer, proceed as follows:

1. Plumbing Piping Distribution Systems: Includes domestic water piping and natural gas piping.

    a. Verify that all valves and accessories have been installed correctly, are accessible and operate as intended.
    b. Verify that specified tests of piping are complete.

2. Plumbing Equipment: Includes pumps, backflow preventers and hot water heating equipment.

    a. Verify that all equipment has been installed in accordance with the manufactures recommendations and all equipment can be easily accessed for maintenance.
    b. Verify that all valves, trim, fittings, controls, and accessories have been installed correctly and operates as intended.
    c. Verify that all equipment test, training, and startup procedures have been completed per the specifications.

d. Verify that all required interfaces with the BAS have been installed correctly and operates as intended.
e. Operate equipment as intended to ensure the design conditions can be obtained.

END OF SECTION 220800

# SECTION 221101 – LEAK TEST PLUMBING PIPING SYSTEMS

## PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 22.

1.2 SUMMARY

A. This Section includes leak testing of the following systems:

1. Sanitary waste and vent piping.
2. Storm water piping.
3. Domestic water system.
4. Natural gas piping.

1.3 SUBMITTALS

A. General: Submit completed certified test reports in “pdf” format for each item in this Section according to the conditions of the contract and Division 01 Specification Sections.

1.4 QUALITY ASSURANCE

A. Testing shall be performed by the installer of system being tested in presence of the Owner Representative.

1.5 WARRANTY/GUARANTEE

A. See Division 22, Specification Section “Basic Mechanical Requirements – Plumbing” for warranty and guarantee requirements.

## PART 2 - PRODUCTS

2.1 PIPE SYSTEM LEAK TEST APPARATUS

A. The contractor conducting the test shall arrange for and provide all temporary services, all test apparatus, all gages, hoses and qualified personnel necessary to conduct the required testing. All leak tests shall be witnessed by Owner’s Representative. Owner requires a minimum of seven (7) business days’ notice for all leak test. Prior to scheduling the test with the Owner the contractor shall pretest the system or segment to ensure all joints, connections etc. are leak free.

B. Test apparatus shall include a pump of appropriate size and pressure for all pressurized systems and an oil free air compressor or gaseous nitrogen to pressurize all gaseous piping systems to the required test pressures. Gauges used for testing shall be as follows:

1. Gauges shall be four (4) inch diameter dial type gauges.
2. Tests requiring a pressure of 10 pounds per square inch (psi) or less shall utilize a testing gauge having increments of 0.10 psi or less.

3. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall utilize a testing gauge having increments of 1 psi or less.
4. Tests requiring a pressure of greater than 100 psi shall utilize a testing gauge having increments of 2 psi or less.

C. Pressure gauges used for the test shall be in the required range and increment for the appropriate test.

D. All gauges must be set at zero (0) before pressure is applied to the test segment.

E. The contractor conducting the test shall utilize the "Standard Pipe System Leak Test Summary Form" for each pipe test to record the test results. Where multiple tests are conducted on the same pipe section a summary report of each test (pass and failed test) shall be prepared. Each summary report shall be signed by each of the parties witnessing the test. The completed reports shall be forwarded to the Construction Manager (CM) or the General Contractor (GC). The CM or GC shall provide a copy of the reports to Owner Project Manager.

**PART 3 - EXECUTION**

3.1 BUILDING DRAINAGE PIPING SYSTEMS

A. The Contractor conducting the test shall provide the necessary test plugs appropriately sized for the piping to be tested, air compressor, the temporary ten (10) foot vertical pipe and shall use the specified Test Procedure for the Building Drainage Piping Systems. The Building Drainage Piping Systems include all: Storm Water, Sanitary Waste, Acid Waste, Sanitary Vent and Acid Vent Piping Systems both in the building below floor slabs, above floor slabs concealed and exposed and below grade to a point five (5) feet beyond the exterior foundation walls.

B. Except for outside leaders and perforated or open-jointed drain tile, test all piping as a whole or in sections as required by progress of work in the plumbing drainage and venting systems below grade and floor slabs and above floor slabs on completion of roughing-in piping installation

1. Where the Building Drainage Piping Systems and/or segments or installed below floor slabs or below grade that portion of the system must be tested and proven leak free before the excavation is back filled and/or floor slabs are poured. The circumference of all pipe joints must be exposed for the test period.

2. Where the Building Drainage Piping Systems and/or segments or installed above floor slabs in walls, partitions, shafts or above ceilings that portion of the system must be tested and proven leak free before the walls, partitions, shafts and/or ceilings are closed in.

C. For Building Piping Drainage Systems above floor slabs inside the building provide a ten (10) foot section of vertical pipe that is connected to the pipe system or segment that is to be tested. Tightly close all openings in piping system and fill the piping slowly with water to the point of overflow at the top of the vertical pie. The water level shall not drop during the one (1) hour test period. During the test period inspect the joints for leaks. If no leaks are detected and the water level has not dropped then the tested pipe system or segment has passed the test. Remove the test plugs, drain the piping and remove the ten (10) foot vertical pipe used for the test unless that pipe section can be used for the next installed segment of piping.

D. For Building Piping Drainage Systems below grade within five (5) feet of the building, below the floor slabs inside the building provide a ten (10) foot section of vertical pipe that is connected to the pipe system or segment that is to be tested. Tightly close all openings in piping system and fill the piping

slowly with water to the point of overflow at the top of the vertical pipe. The water level shall not drop during the one (1) hour test period. During the test period inspect the joints for leaks. If no leaks are detected and the pressure has not dropped then the tested pipe system or segment has passed the test. Remove the test plugs and evacuate the compressed air in the piping.

E. If leaks are detected and/or the water level has dropped then the tested pipe system or segment the test has failed. After the leaks have been corrected by tightening, repairing or replacing components as appropriate the appropriate test shall be rescheduled with the Owner. The test procedure shall be repeated as specified above until there are no leaks and there is no allowable drop in the water level or pressure.

3.2 DOMESTIC WATER PIPING SYSTEMS

A. The contractor conducting the test shall use this Test Procedure for Domestic Water and RO/DI Piping Systems. Test each pipe system as a whole or in segments as required by progress of the work. Perform tests prior to installation of piping insulation.

B. All Piping Systems include piping exposed and concealed above grade within the building, piping below floor slabs within the building, piping below grade five (5) feet beyond the exterior foundation wall, and / or piping above the building roof elevation and are defined as follows:

1. Domestic Water Piping Systems include all Cold Water, Hot Water, Hot Water Recirculating Piping serving non laboratory areas of the building and/or the project area.

C. Use ambient temperature water as the testing medium, except where there is a risk of damage due to freezing. Another liquid may be used if it is safe for workmen and compatible with the piping system components.

D. Use vents installed at high points in the system to release trapped air while filling the system. Use drains installed at low points for complete removal of the liquid.

E. Examine system to see that equipment and parts that cannot withstand test pressures are properly isolated. Examine test equipment to ensure that it is tight and that low pressure filling lines are disconnected.

F. Subject piping system to a hydrostatic test pressure which at every point in the system is not less than one and one half (1-1/2) times the design pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in the system under test. Make a check to verify that the stress due to pressure at the bottom of vertical runs does not exceed either 90% of specified minimum yield strength, or 1.7 times the ”SE” value in Appendix A of ASME B31.9, Code For Pressure Piping, Building Services Piping.

G. After the hydrostatic test pressure has been applied for one (1) hour and with no allowable drop in pressure, the tested system or segment has passed the leak test. If after the one (1) hour test period there is a loss in pressure below the initial test pressure, the test has failed and the contractor shall examine piping, joints, and connections for leakage. After all leaks have been corrected by tightening, repairing, and/or replacing components as appropriate, the hydrostatic test shall be rescheduled with the Owner. The test procedure shall be repeated as specified above until there are no leaks and there is no loss in pressure.

H. Where backflow preventers are installed in piping systems scheduled for testing isolate the backflow preventer from the piping to be tested.

3.3 NATURAL GAS PIPING SYSTEM

A. The contractor conducting the test shall use this Test Procedure for Natural Gas Piping Systems. Test each pipe system as a whole or in segments as required by progress of the work. Cap and fill each system, with oil-free, dry air or dry nitrogen, to pressure of one and one half (1-1/2) times the system operating pressure, but not less than fifty (50) psig. Isolate the test source and let stand for four (4) hours to equalize temperature. Refill system, if required, to test pressure and hold pressure for one (1) hour with no allowable drop in pressure.

B. Inspect and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

C. After erection of the tubing, but before installation of outlet valves, the line shall be blown clear by means of dry nitrogen.

D. After installation of outlet valves, each section shall be subject to a test pressure of at least one and one half (1-1/2) time the maximum working pressure, but not less than fifty (50) pounds per square inch by means of dry nitrogen. This test pressure shall be maintained until each joint has been examined for leakage by means of Oxweld No. 23 Lake Test Solution of other non-frothing solutions approved for this purpose.

E. Where leakage or other defects are located in each system, the affected portion of the piping system shall be repaired or replaced in that section of piping. After the leaks have been corrected by tightening, repairing or replacing components as appropriate the test shall be rescheduled with the Owner. Retesting can occur no sooner than five (5) business days after a failed test. The test procedure shall be repeated as specified above until there are no leaks and there is no allowable drop in pressure.

F. Before the installation of outlet valves and placing the system in service each laboratory gas piping system shall be purged with dry nitrogen.

3.4 STANDARD TEST SUMMARY FORMS:

A. General: The contractor shall use the “Standard Pipe System Leak Test Summary Form.”

1. Sample Form: The following page contains a sample of the Owner Standard Pipe System Leak Test Summary Form.

STANDARD PIPE SYSTEM LEAK TEST SUMMARY FORM

Date: _____ Project Number: _____

Location: _____

Pipe System Tested (Service): _____

Location and Description: _____

Pipe Materials: _____

Operating Pressure: _____

Specified Test Pressure: _____

Actual Test Pressure: _____

Pressure Test Type: _____

Test Start Time: _____ Recorded Test Pressure: _____

Test Completion Time: _____ Recorded Test Pressure: _____

Test Duration: _____ Pressure Drop or Rise: _____

Test Result (Pass/Fail): _____ Weather Conditions: _____

Construction Manager: _____

Construction Manager Representative: _____

Mechanical Contractor: _____

Mechanical Contractor Forman: _____

Owner Witness: _____

Remarks: _____

END OF SECTION 221101

# SECTION 221116 - DOMESTIC WATER PIPING

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic water pipes, tubes, and fittings inside buildings.

2. Encasement for piping.

1.2 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.4 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.

2. Do not interrupt water service without Owner’s written permission.

## PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.

2. Cast-copper-alloy, hexagonal-stock body.

3. Ball-and-socket, metal-to-metal seating surfaces.

4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:

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

a. Elkhart Products Corporation.

b. NIBCO Inc.

c. Viega.

2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Copper Push-on-Joint Fittings:

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

a. Victaulic Company.

2. Description:

a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.

b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

I. Copper-Tube, Extruded-Tee Connections:

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

a. T-Drill Industries Inc.

2. Description: Tee formed in copper tube according to ASTM F 2014.

J. Appurtenances for Grooved-End Copper Tubing:

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

a. Anvil International.

b. Shurjoint Piping Products.

c. Victaulic Company.

2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings.

3. Mechanical Couplings for Grooved-End Copper Tubing:

a. Copper-tube dimensions and design similar to AWWA C606.

b. Ferrous housing sections.

c. EPDM-rubber gaskets suitable for hot and cold water.

d. Bolts and nuts.

e. Minimum Pressure Rating: 300 psig.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.

2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.

1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Solvent cement and adhesive primer 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."

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.

2. Pressure rating at least equal to pipes to be joined.

3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

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

a. Cascade Waterworks Manufacturing.

b. Dresser, Inc.; Piping Specialties Products.

c. Ford Meter Box Company, Inc. (The).

d. JCM Industries.

e. Romac Industries, Inc.

f. Smith-Blair, Inc.; a Sensus company.

g. Viking Johnson.

D. Plastic-to-Metal Transition Fittings:

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

a. Charlotte Pipe and Foundry Company.

b. Harvel Plastics, Inc.

c. Spears Manufacturing Company.

2. Description:

a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.

b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

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

a. Colonial Engineering, Inc.

b. NIBCO Inc.

c. Spears Manufacturing Company.

2. Description:

a. CPVC four-part union.

b. Brass or stainless-steel threaded end.

c. Solvent-cement-joint or threaded plastic end.

d. Rubber O-ring.

e. Union nut.

2.6 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. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model DUXL (Lead-Free), Model DUXLC (Lead-Free), Model DUXLM (Lead-Free) or comparable product by one of the following:

a. Capitol Manufacturing Company; member of the Phoenix Forge Group.

b. Central Plastics Company.

c. Hart Industries International, Inc.

d. Matco-Norca.

e. Watts; a division of Watts Water Technologies, Inc.

2. Standard: ASSE 1079.

3. Pressure Rating: 125 psig minimum at 180 deg F, 150 psig, 250 psig

4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Industries, LLC; Wilkins; Model DUXLC (Lead-Free) or comparable product by one of the following:

a. Capitol Manufacturing Company; member of the Phoenix Forge Group.

b. Central Plastics Company.

c. Matco-Norca.

d. Watts; a division of Watts Water Technologies, Inc.

2. Standard: ASSE 1079.

3. Factory-fabricated, bolted, companion-flange assembly.

4. Pressure Rating: 125 psig minimum at 180 deg F, 150, 175 psig, 300 psig.

5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

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

a. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Central Plastics Company.

d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.

3. Pressure Rating: 150 psig.

4. Gasket: Neoprene or phenolic.

5. Bolt Sleeves: Phenolic or polyethylene.

6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

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

a. Elster Perfection Corporation.

b. Grinnell Mechanical Products; Tyco Fire Products LP.

c. Matco-Norca.

d. Precision Plumbing Products, Inc.

e. Victaulic Company.

2. Standard: IAPMO PS 66.

3. Electroplated steel nipple complying with ASTM F 1545.

4. Pressure Rating and Temperature: 300 psig at 225 deg F.

5. End Connections: Male threaded or grooved.

6. Lining: Inert and noncorrosive, propylene.

**PART 3 - EXECUTION**

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground [copper tube] [and] [ductile-iron pipe] in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

G. Install domestic water piping level and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

K. 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.

L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install PEX piping with loop at each change of direction of more than 90 degrees.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

J. Joint Construction for Solvent-Cemented Plastic Piping: 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. Apply primer.

2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Piping: Join according to ASTM D 2855.

K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

## 3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.

2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

## 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 or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

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 to NPS 5: 10 feet with 1/2-inch rod.

6. NPS 6: 10 feet with 5/8-inch rod.

7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inc rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.

6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

7. NPS 6: 12 feet with 3/4-inch rod.

8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

G. Install supports for vertical steel piping every 15 feet.

H. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.

6. NPS 4 and NPS: 12 feet with 5/8-inch rod.

7. NPS 6: 12 feet with 3/4-inch rod.

8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

I. Install supports for vertical stainless-steel piping every 15 feet.

J. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.

2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.

3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.

4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.

5. NPS 6: 48 inches with 3/4-inch rod.

6. NPS 8: 48 inches with 7/8-inch rod.

K. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

L. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 and Smaller: 32 inches with 3/8-inch rod.

M. 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. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.

2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

4. 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. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 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. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.

b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 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.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Repeat procedures if biological examination shows contamination.

e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

2. Mechanical-joint, ductile-iron pipe; standard or compact pattern, mechanical-joint fittings; and mechanical joints.

3. Push-on-joint, ductile-iron pipe; standard or compact pattern, push-on-joint fittings; and gasketed joints.

4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

F. Under-building-slab, domestic water piping, NPS 2 and smaller shall be one of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed joints.

G. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper, solder-joint fittings; and soldered joints.

2. Hard copper tube, ASTM B 88, Type L; cast or wrought copper, solder-joint fittings; soldered joints

H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Hard copper tube, [ASTM B 88, Type L; cast or wrought copper, solder-joint fittings; and soldered joints.

I. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L, ASTM B 88, Type M; cast or wrought copper, solder-joint fittings; and soldered 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 or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.

4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

# SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Water-hammer arresters.
2. Trap-seal primer device.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.

1. Include diagrams for power, signal, and control wiring.

### 1.3 INFORMATIONAL SUBMITTALS

A. Test and inspection reports.

B. Field quality-control reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

### 2.2 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters <Insert drawing designation if any>:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.3 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device :

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig (860 kPa) minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Device :

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.
2. Size: NPS 1-1/4 (DN 32) minimum.
3. Material: Chrome-plated, cast brass.

**PART 3 - EXECUTION**

3.1 INSTALLATION OF PIPING SPECIALTIES

A. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

B. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

C. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.2 PIPING CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Trap-seal primer device.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections.

C. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

# SECTION 221316 - SANITARY WASTE AND VENT PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Cast-iron soil pipe and fittings.
2. Copper tube and fittings.
3. PVC pipe and fittings.
4. Specialty pipe fittings.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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.

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.4 WARRANTY

A. Listed manufacturers to provide labeling and warranty of their respective products.

## 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 CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

2.4 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

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.

**PART 3 - EXECUTION**

3.1 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 soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping smaller than NPS 3; 1 percent downward in direction of flow for piping NPS 3 and larger.
2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Install aboveground PVC piping according to ASTM D 2665.

P. Install underground PVC piping according to ASTM D 2321.

Q. 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."

R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

S. 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."

T. 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."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors.

1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

## 3.2 JOINT CONSTRUCTION

A. Join cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

D. 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 appendixes.

## 3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: Shielded, nonpressure transition couplings.

## 3.4 INSTALLATION OF HANGERS AND SUPPORTS

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 pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

    a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install hangers for] soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.

E. Support vertical runs of soil piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

## 3.5 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.
5. Install horizontal backwater valves with cleanout cover flush with floor.
6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
7. Equipment: Connect waste piping as indicated.

    a. Provide shutoff valve if indicated and union for each connection.
    b. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

## 3.6 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."

## 3.7 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 (30 kPa).
    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 (250 Pa).
    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.

## 3.8 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. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping shall be as specified on the construction documents.

END OF SECTION 221316

# SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Miscellaneous sanitary drainage piping specialties.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

## 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 CLEANOUTS

A. Cast-Iron Exposed Cleanouts :

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping.
3. Body Material as required to match connected piping.

B. Cast-Iron Exposed Floor Cleanouts:
1. Standard: ASME A112.36.2M for adjustable housing cleanout.

2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Adjustable Housing Material: Cast iron.
6. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
7. Frame and Cover Shape: Round.
8. Top-Loading Classification: Heavy Duty.
9. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body:Hubless, cast-iron soil pipe test tee] as required to match connected piping.
4. Closure Plug:

    a. Brass.
    b. Countersunk head.
    c. Drilled and threaded for cover attachment screw.
    d. Size: Same as or not more than one size smaller than cleanout size.

5. Wall Access, Cover Plate: Round flat, chrome-plated brass cover plate with screw.
6. Wall Access, Frame and Cover: Square, stainless steel wall-installation frame and cover.

D. Plastic Floor Cleanouts:

1. Size: Same as connected branch.
2. Body: PVC.
3. Closure Plug: PVC.
4. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. 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 (DN 100). Use NPS 4 (DN 100) 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 (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate at base of each vertical soil and waste stack.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

D. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.

3.2 PIPING 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.

3.3 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."

3.4 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

# SECTION 221413 - FACILITY STORM DRAINAGE PIPING

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.

2. Specialty pipe fittings.

3. Encasement for underground metal piping.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

2. Storm Drainage, Force-Main Piping: 50 psig.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of storm-drainage service.

2. Do not proceed with interruption of storm-drainage service without Owner's written permission.

**PART 2 - PRODUCTS**

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

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

a. ANACO-Husky.

b. Dallas Specialty & Mfg. Co.

c. Fernco Inc.

d. Matco-Norca, Inc.

e. MIFAB, Inc.

f. Mission Rubber Company; a division of MCP Industries, Inc.

g. Stant.

h. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

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

a. ANACO-Husky.

b. Clamp-All Corp.

c. Dallas Specialty & Mfg. Co.

d. MIFAB, Inc.

e. Mission Rubber Company; a division of MCP Industries, Inc.

f. Stant.

g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

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

a. MG Piping Products Company.

2. Standard: ASTM C 1277.

3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Adhesive primer 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. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Solvent cement 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."

**PART 3 - EXECUTION**

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations from 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 storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard

increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

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."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

M. Install steel piping according to applicable plumbing code.

N. Install aboveground PVC piping according to ASTM D 2665.

O. Install underground PVC piping according to ASTM D 2321.

P. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

Q. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

R. Install force mains at elevations indicated.

S. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."

2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

C. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

D. Plastic, Nonpressure-Piping, Solvent-Cemented 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.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.

2. In Drainage Piping: Shielded, nonpressure transition couplings.

3. In Aboveground Force-Main Piping: Fitting-type transition couplings.

4. In Underground Force-Main Piping:

a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.

b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.4 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 and smaller.

2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.

2. Install backwater valves in accessible locations.

3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. 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 pipe hangers for horizontal piping in noncorrosive environments.

2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.

3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.

5. Vertical Piping: MSS Type 8 or Type 42, clamps.

6. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.

2. NPS 3: 60 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 60 inche 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 pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 fee.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3: 12 feet with 1/2-inch rod.

6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

7. NPS 6 and NPS: 12 feet with 3/4-inch rod.

8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.

2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.

3. NPS 2-1/2: 108 inches with 1/2-inch rod.

4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

5. NPS 6: 10 feet with 5/8-inch rod.

6. NPS 8: 10 feet with 3/4-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

L. Install hangers for ABS and PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.

2. NPS 3: 48 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.

4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.

5. NPS 10 and NPS 12: 48 inches with 7/8-inch rod.

M. Install supports for vertical PVC piping every 48 inches.

N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

2. Install horizontal backwater valves with cleanout cover flush with floor.

3. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."

D. Connect force-main piping to the following:

1. Storm Sewer: To exterior force main.

2. Sump Pumps: To sump pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping. 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.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not

less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI, or heavy-duty, hubless-piping couplings; and coupled joints.

3. Solid-wall, PVC pipe, PVC socket fittings, and solvent-cemented joints.

4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, storm drainage piping NPS 8 and larger shall bet any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI, or heavy-duty, hubless-piping couplings; and coupled joints.

3. Solid-wall, PVC pipe, PVC socket fittings, and solvent-cemented joints.

4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Underground storm drainage piping NPS 6 and smaller shall be any of the following:

1. Extra Heavy or Service class, cast-iron soil pipe and fittings and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI, or heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.

3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

E. Underground, storm drainage piping NPS 8 and larger shall be any of the following:

1. Extra Heavy or Service class, cast-iron soil pipe and fittings and gasketed joints.

2. Hubless, cast-iron soil pipe and fittings; CISPI, heavy-duty, cast-iron, hubless-piping couplings; and coupled joints.

3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

F. Aboveground storm drainage force mains NPS 1-1/2 and NPS 2 shall be any of the following:

1. Hard copper tube, copper pressure fittings, and soldered joints.

G. Aboveground storm drainage force mains NPS 2-1/2 to NPS 6 shall be any of the following:

1. Hard copper tube, copper pressure fittings, and soldered joints.

2. Fitting-type transition couplings if dissimilar pipe materials.

H. Underground storm drainage force mains NPS 4 and smaller shall be any of the following:

1. Hard copper tube; wrought-copper pressure fittings; and soldered joints.

2. Ductile-iron, mechanical-joint piping and mechanical joints.

3. Ductile-iron, push-on-joint piping and push-on joints.

4. Ductile-iron, grooved-joint piping and grooved joints.

5. Fitting-type transition coupling for piping smaller than NPS 1-1/2 and pressure transition coupling for NPS 1-1/2 and larger if dissimilar pipe materials.

I. Underground storm drainage force mains NPS 5 and larger shall be any of the following:

1. Hard copper tube; wrought-copper pressure fittings; and soldered joints.
2. Ductile-iron, mechanical-joint piping and mechanical joints.
3. Ductile-iron, push-on-joint piping and push-on joints.
4. Ductile-iron, grooved-joint piping and grooved joints.
5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 221413

# SECTION 221423 STORM DRAINAGE PIPING SPECIALTIES

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous storm drainage piping specialties.
2. Cleanouts.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

## PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping.
3. Body Material as required to match connected piping.

B. Cast-Iron Exposed Floor Cleanouts:

1. Standard: ASME A112.36.2M for adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Adjustable Housing Material: Cast iron.
6. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
7. Frame and Cover Shape: Round.
8. Top-Loading Classification: Heavy Duty.
9. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body:Hubless, cast-iron soil pipe test tee] as required to match connected piping.
4. Closure Plug:

a. Brass.
b. Countersunk head.
c. Drilled and threaded for cover attachment screw.
d. Size: Same as or not more than one size smaller than cleanout size.

5. Wall Access, Cover Plate: Round flat, chrome-plated brass cover plate with screw.
6. Wall Access, Frame and Cover: Square, stainless steel wall-installation frame and cover.

D. Test Tees:

1. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
2. Size: Same as connected drainage piping.
3. Body Material: Cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk, brass.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

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 test tees in vertical conductors and near floor.

F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

G. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Section 078413 "Penetration Firestopping".

H. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

## 3.2 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

## 3.3 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 221423

# SECTION 230500 COMMON WORK RESULTS FOR HVAC

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. HVAC demolition.
8. Equipment installation requirements common to equipment sections.
9. Concrete bases.
10. Supports and anchorages.

### 1.2 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

### 1.3 SUBMITTALS

A. Welding certificates.

### 1.4 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## PART 2 - PRODUCTS

### 2.1 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

### 2.2 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Plastic. Include two for each sealing element.

D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### 2.3 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. PVC Pipe: ASTM D 1785, Schedule 40.

C. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.4 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

2.5 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

**PART 3 - EXECUTION**

3.1 HVAC DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: indicated to be removed.
2. Ducts to Be Removed: indicated to be removed.
3. Equipment to Be Removed: Disconnect services and remove equipment.
4. Equipment to Be Removed and Salvaged: Disconnect and remove equipment and deliver to Owner.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors.

M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

END OF SECTION

# SECTION 230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

### 1.2 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 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

### 2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. 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.

### 2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

## 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. 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.

B. Motors Used with Variable Frequency Controllers:

1. 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.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

## 2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.

4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. 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 shall automatically reset when motor temperature returns to normal range.

**PART 3 - EXECUTION (Not Applicable)**

END OF SECTION 230513

# SECTION 230529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes the following:

1. Metal framing systems.
2. Thermal-hanger shield inserts.
3. Fastener systems.
4. Equipment supports.

B. See Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for equipment supports.

### 1.2 DEFINITIONS

A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

### 1.3 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

### 1.4 SUBMITTALS

A. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Metal framing systems. Include Product Data for components.
2. Equipment supports.

B. Welding certificates.

### 1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

### 2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.4 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.5 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

**PART 3 - EXECUTION**

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

C. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

D. 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.

E. Install lateral bracing with pipe hangers and supports to prevent swaying.

F. 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 (DN 65) 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.

G. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

## 3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

## 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 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

## 3.5 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

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

END OF SECTION 230529

# 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. Pipe labels.
4. Duct labels.

1.2 SUBMITTAL

A. Product Data: For each type of product indicated.

## PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm),

and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches (38 mm) high.

**PART 3 - EXECUTION**

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

C. Pipe Label Color Schedule:

1. Refrigerant Piping:

a. Background Color: Yellow.
b. Letter Color: Black.

3.3 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.
2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
3. ANSI A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION 230553

# SECTION 230593 TESTING, ADJUSTING, AND BALANCING FOR HVAC

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes TAB to produce design objectives for the following:

1. Air Systems:

   a. Constant-volume air systems.
   b. Variable-air-volume systems.

2. Hydronic Piping Systems:

   a. Constant-flow systems.
   b. Variable-flow systems.

3. HVAC equipment quantitative-performance settings.
4. Verifying that automatic control devices are functioning properly.
5. Reporting results of activities and procedures specified in this Section.

### 1.2 SUBMITTALS

A. Strategies and Procedures Plan: Within 15 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. Warranties specified in this Section.

D. LEED Submittals:

1. Air-Balance Report for LEED Prerequisites EQ 1: Documentation for work performed for ASHRAE 62.1-2007, Section 7.2.2, “Air Balancing”.

### 1.3 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by AABC.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing".

## 1.4 PROJECT 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.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## 1.5 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

## 1.6 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

**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.

1. Verify that balancing devices and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 01 Section "Project Record Documents."

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 equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine equipment for installation and for properly operating safety interlocks and controls.

N. Examine automatic temperature system components to verify the following:

1. Dampers and other controlled devices are operated by the intended controller.
2. Dampers are in the position indicated by the controller.
3. Integrity of dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in mixing boxes, and variable-air-volume terminals.
4. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
5. Sensors are located to sense only the intended conditions.
6. Sequence of operation for control modes is according to the Contract Documents.
7. Controller set points are set at indicated values.
8. Interlocked systems are operating.
9. Changeover from heating to cooling mode occurs according to indicated values.

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 strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

## 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems"; NEBB's "Procedural Standards for Testing, Adjusting,

and Balancing of Environmental Systems", SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and this Section.

B. Cut insulation, ducts and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

## 3.4 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' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

## 3.5 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 fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
b. Measure static pressure directly at the fan outlet or through the flexible connection.
c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
6. 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 will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, sub main ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.

a. Where sufficient space in sub main and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each sub main and branch duct after all have been adjusted. Continue to adjust sub main and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

## 3.6 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

## 3.7 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

## 3.8 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Check main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

## 3.9 TOLERANCES

A. Set HVAC system airflow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.

## 3.10 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. 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, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
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 firm 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, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

a. Settings for outside-, return-, and exhaust-air dampers.
b. Conditions of filters.
c. Cooling coil, wet- and dry-bulb conditions.
d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Inlet vane settings for variable-air-volume systems.
g. Settings for supply-air, static-pressure controller.
h. Other system operating conditions that affect performance.

E. 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 outside, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Terminal units.
4. Balancing stations.
5. Position of balancing devices.

## 3.11 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

# SECTION 23 07 00 HVAC INSULATION

## PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections:

1. 15510 - Piping (HVAC).
2. 15410 - Piping (Plumbing).
3. 15515 - Valves, Hangers, and Specialties.
4. 15540 - Pumping Equipment (HVAC).
5. 15841 - Low Pressure Steel Ductwork.
6. 15890 - Ductwork.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. C534-94 Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
2. C547-95 specification for Mineral Fiber Pipe Insulation.
3. C552-91 Specification for Cellular Glass Thermal Insulation.
4. C553-92 Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
5. C585-90 Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
6. C612-93 Specification for Mineral Fiber Block and Board Thermal Insulation.
7. D1056-91 Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
8. D1668-95 Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing.
9. E84-96a Test Method for Surface Burning characteristics of Building Materials.
10. E96-95 Test Methods for Water Vapor Transmission of Materials.

B. National Bureau of Standards (NBS).
C. National Fire Protection Institute: NFPA 90A.
D. Underwriters Laboratories (UL) - 723.
E. Insulation Contractor’s Association of South Florida Inc.

1.3 SUBMITTALS

A. Submit properly identified manufacturer's catalog cuts, performance curves, and procedures before starting work.

1.4 DELIVERY AND STORAGE

A. Protect materials from the weather during storage and installation.

1.5 QUALITY ASSURANCE

A. Materials shall be labeled, listed, or have certified test reports submitted from testing laboratory accepted by the Board.
B. Comply with the most stringent requirements between the Insulation Contractors Association of

South Florida Inc. and as specified.

C. There shall be no fiberglass in contact with the HVAC airstream anywhere in the system whether protected by encapsulation or not.

D. Foam plastic insulation shall be certified by an independent third-party national recognized laboratory, that the product emits less than 1 part per million formaldehyde out gassing after 24 hours.

1.6 FIRE HAZARD RATING

A. Fire hazard rated materials shall be UL labeled or a certified test report by a accepted testing laboratory shall be submitted indicating compliance with specified fire hazard requirements.

B. Insulation (including adhesives) shall be fire retardant or self-extinguishing. Finishing jackets, insulation, and adhesives shall have composite fire and smoke ratings complying with ASTM E84, NFPA 255, and UL 723, as plain or on a composite basis.

C. When insulation, vapor barrier covering, wrapping materials, and adhesives are applied separately in field, each item shall be tested individually.

D. When insulation, vapor barrier covering, wrapping materials, and adhesives are factory composite systems, they shall be tested as an assembly.

E. Insulation materials, adhesives, coatings, and other accessories shall have a fire hazard rating not more than 25 for flame developed and not more than 50 for fuel contributed and smoke developed, except as follows:

1. Flexible unicellular insulation.
2. Nylon anchors for securing insulation to ducts or equipment.
3. Factory premolded 1 piece PVC fitting and valve covers

F. Flame resistance treatments subject to deterioration due to effects of moisture or high humidity are not acceptable.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Insulation:

1. Armaflex.
2. Armstrong.
3. Certain-Teed.
4. Cell-U-Foam.
5. Foamglas.
6. Manville.
7. Owens-Corning.
8. Pittsburgh Corning.

B. Insulating Cement:

1. Keene Powerhouse.
2. Benjamin Foster.
3. Fibrex FBX fast set.

2.2 MATERIALS

A. Insulation: Type and thickness as specified.

1. Provide fire retardant or self-extinguishing insulation, including adhesives.
2. Finishing jackets, insulation, and adhesives shall have composite fire and smoke ratings per ASTM E84, NFPA 255, and UL 723.

B. Domestic Hot Water Supply and Return Piping Insulation:

1. 1" thick molded fiberglass insulation with pre-sized factory applied FRJ jacket of glass cloth with longitudinal lap and butt joint strips with self-sealing adhesive.
2. Insulation may be 1/2" insulation for vertical branches to individual fixtures.
3. Minimum density of 7-1/4 pounds per cubic foot, maximum thermal conductivity factor of 0.26K at 75 degrees F. mean temperature, and alkalinity of 0.696.
4. Flame Spread: 25 or less.
5. Smoke Developed: 50 or less.
6. Accessories: Adhesives, mastics, cements, tapes for fittings, and related materials shall have the same composite ratings as listed above.

C. Cold Drainage Piping such as A/C Condensate Drain, Drinking Fountain, and Electric Water Cooler Drain Piping Insulation:

1. Elastomeric (foam plastic) thermal insulation 1 inch thick with built-in vapor barrier rated self-extinguishing ASTM D1056.
2. Maximum thermal conductivity factor of 0.26K at 70 degrees F. mean temperature, density of 5-6 pounds per cubic foot, and a water vapor transmission of 0.1 perms.

D. Tape: As recommended by the insulation manufacturer or 3M adhesive EC-1329.
E. Insulating Cement: All-purpose mineral wool cement.
F. Glass Cloth Jacket: Factory sized white, standard weight, with 1-1/2" minimum longitudinal pressure sealing lap and seal strips for butt joints.
G. Vapor Barrier Jacket:

1. Flame resistant glass fiber adhered to outside of a 1 mil aluminum foil sheet with longitudinal pressure sealing lap and seal strips for butt joints.
2. End cement perm rating shall not exceed 0.05.

H. Weatherproof Metal Jacket (Exterior Above Ground Only):

1. Damage and corrosion resistant, longitudinal seam closure, joint construction capable of locking insulation and jacket securely in place.
2. Seal and weatherproof butt joints with factory supplied 2 inch wide "snap-straps" lined with plastic sealing compound secured with outer holding band.
3. Jacket Material: O.016 aluminum.

I. Molded Fiberglass Pipe Insulation:

1. Rigid molded sectional pipe covering with integral factory jacket.
2. Comply with ASTM C547.
3. Maximum Thermal Conductivity: 0.23K factor at 75 degrees F. mean temperature.
4. Alkalinity: Less than 0.6 percent.

J. Foamed Plastic Insulation:

1. Closed cell.
2. Comply with ASTM C534.

3. Maximum Thermal Conductivity: 0.27K factor at 75 degrees F. mean temperature.
4. Water Vapor Permeability: 0.1 perms.

K. Cellular Glass Insulation:

1. Comply with ASTM C552
2. Maximum Thermal Conductivity: 0.33 K factor at 75 degrees F.
3. Water Vapor Permeability: 0.00 perm-in.

L. Flexible Fiberglass Ductwrap Blanket Insulation:

1. 2.0/2.2/2.3 inches thick, 1" pcf density fiberglass blanket with UL approved aluminum foil vapor seal facing reinforced with fiberglass scrim, laminated to 30 lb. kraft paper, R = 6.5 (Min.).
2. Comply with ASTM C553, TYPE I, Class B-4.
3. Maximum Thermal Conductivity: 0.24K factor at 75 degrees F.

M. Rigid Fiberglass Ductboard Insulation:

1. Comply with ASTM C612.
2. Maximum Thermal Conductivity: 0.24K factor at 75 degrees F.
3. Provide scrim foil facing having a minimum 3 pcf density, 2 inches thick.

N. Accessories:

1. The following accessories shall be used in the application of thermal insulation:

a. PVC fittings cover and PVC jacketing:

1) Certain-Teed "Snap Form".
2) Manville Corp. "Zeston".
3) Proto.

b. Vapor Seal Mastic:

1) Benjamin Foster 30-86 or 30-25.
2) Childers CP-30.

c. Lagging Adhesive:

1) Benjamin Foster 81-42W.
2) Childers CP-50.

d. Breather Mastic:

1) Benjamin Foster 45-00 or 30-86.
2) Childers CP-10.

e. Insulation Bonding Adhesive (to metal):

1) Benjamin Foster 85-20, or 85-15.
2) Childers CP-82.

f. Insulating and Finishing Cement:

1) Fibrex Inc. FBX Super Blend Cement.
2) Manville Corp. No.375 Insulating and Finishing Cement.
3) Keene Corp. Super Powerhouse.

g. Coatings: Sealfas G-P-M mastic or accepted equivalent.
h. Fire Resistive Mastic: As manufactured by Benjamin Foster or accepted equivalent.
i. Sealants: 81-33 as manufactured by Benjamin Foster or accepted equivalent.
j. Staples: Type 304 or 316 stainless steel outward clinching type.
k. Wire: 16 gage, copper weld wire.
l. Bands: 3/4 by 0.015" thick galvanized steel.
m. Glass Fabric:

1) Woven open mesh type glass fabric conforming to ASTM D1668.
2) Type I asphalt treated for below ground use.
3) Type III light color organic resin treated for aboveground or below ground use.

n. Insulation Jackets:

1) Jackets inside building shall comply with fire hazard classifications as specified. Insulation jackets shall not support mold growth.
2) Vapor Barrier Jackets:

a) For Cold Pipelines (-30 degrees F. to 60 degrees F.): Perm rating not more than 0.05, ASTM E96 Procedure A. Puncture resistance not less than 50 beach units.
b) For Air-conditioning Ducts: Perm rating not more than 0.05, ASTM E96, Procedure A. Puncture resistance not less than 25 beach units.

2.3 SYSTEMS INSULATION BY TYPE

A. Chilled Water Supply and Return Piping Insulation:

1. 1-1/2" diameter and smaller - copper, aboveground:

a. Foamed Plastic Pipe Insulation: 1 inch thick.
b. Provide vapor barrier mastic for areas subject to conditions of 90 degrees F or 85 percent relative humidity or higher.

2. 2" to 4" diameter - aboveground:

a. Cellular Glass Insulation.
b. Thicknesses as follows:

1) 2 inches thick for interior ceilings not subject to over 90 degrees F. or 85 percent relative humidity.
2) 2-1/2" thick for areas subject to conditions of 90 degrees F or 85 percent relative humidity or higher, such as exterior or perimeter corridors and walkways, whether exposed or concealed, or in ceilings or breezeways.

B. Interior Domestic Hot Water Supply/Return Piping Insulation:

1. Molded Fiberglass Pipe Insulation: 1 inch thick with pre-sized factory applied FRJ jacket of glass cloth with longitudinal lap and butt joint strips with self-sealing adhesive.

2. Contractor's Option: Foamed plastic insulation, 1 inch thick.

C. Electric Water Cooler Drain, Cold Drainage Piping Refrigerant Suction Piping, and Interior Condensate Drain Piping Insulation:

1. Foamed Plastic Insulation: 1 inch thick with field applied vapor barrier mastic at joints.

D. Interior Concealed Ductwork Insulation:

1. Flexible fiberglass Ductwrap Blanket Insulation:

a. 2.0 inches thick, 1.0 pcf density (R=6 installed).
b. 2.0 inches thick, 1-1/2 pcf density (R=6 installed).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation according to applicable codes and regulations.
B. Except as specified, install materials according to manufacturer's recommendations and specifications for obtaining conformance to construction documents.
C. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use and samples required for acceptance shall have manufacturer's stamp or label attached listing manufacturer, brand name, and a description of material.
D. Provide allowances for expansion/contraction, and wall and manhole penetrations.
E. Run continuous through wall, floor, and ceiling penetrations.
F. Insulation materials shall not be applied until:

1. Test results specified in other sections of these specifications are completed and accepted.
2. Rust, scale, dirt, and any other foreign material have been removed.
3. Ductwork or piping material are clean, dry, joints firmly butted together, and tightly sealed at all joints, seams, and fittings.

G. Wrap butt joints with a 3 inch wide strip of the same material as the jacket.
H. Provide aluminum jackets over the insulation where sealant is required.
I. Insulation shall be kept clean and dry at all times.
J. Duct Materials:

1. Internal duct lining is not allowed.
2. Duct materials solid exposed to the airflow shall be noncombustible metal.
3. Duct insulation for thermal or acoustical purposes shall be separated from airflows by solid metal.
4. Provide natural noise attenuation procedures, as recommended in ASHRAE, Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), and industry good engineering practices.
5. Fiberglass ducts or ductboards shall not be used to convey air.

K. Protection Shield: Where pipe or tubing insulation pass through hangers, provide:

1. For Piping 4 inches and smaller: A protection shield, 180 degree arc, 16 gage galvanized sheet metal covering, minimum 12 inches long.
2. For Piping Larger than 4 inch diameter: A protection shield, 180 degree arc, 16 gage galvanized sheet metal covering, minimum 18 inches long.
3. Hangers not exceeding maximum spacing distances recommended by insulation

manufacturer to prevent crushing or compressing insulation.

L. Ductwork sizes shown on drawings are actual internal "air side" dimensions.

M. Flanges, Fittings, and Valves on Insulated Piping:

1. Provide pre-molded glass fiber fittings wired or taped on and adhered with canvas jacket.
2. Terminate insulation and jacket neatly and finish with insulating cement troweled to a bevel and of the same thickness as adjoining insulation.
3. Vapor seal insulation on cold systems.

N. Vapor Barriers:

1. Intact and continuous.
2. Do not install with staples.

O. Omit Pipe Insulation From the Following:

1. Screwed unions, except at "cold drains" and air- conditioning wastes. Terminate insulation neatly at both sides of unions with insulation cement.
2. Discharge lines from safety and relief valves.
3. Nickel or chrome plated piping.

P. All ductwork shall be insulated, except as noted below:

1. Outside air intake ductwork.
2. Exhaust air ductwork.
3. Supply air ductwork, exposed in air-conditioned spaces. (Note: Ceiling plenums, and mechanical equipment rooms are not to be considered air-conditioned spaces.)

Q. Ceiling supply air registers located on perimeter rooms and corridors shall be field insulated with flexible fiberglass ductwrap insulation as specified. Insulation shall cover the upper body and installation flanges.

R. All appurtenances subject to condensation shall be protected as necessary and covered with vapor seal mastic.

3.2 APPLICATIONS

A. Molded Fiberglass Pipe Insulation Installation (Hot Water Supply/Return):

1. Tightly butt together sections of insulation on pipe runs sealing longitudinal seams of jacket with self- sealing laps. Position longitudinal seam so seam is on bottom to prevent dirt and moisture infiltration. Seal end joints with 3 inch wide straps of vapor barrier tape. Seal ends of insulation with vapor seal mastic at valves, fittings and flanges.
2. Cover valves, fittings, and flanges with insulation similar to adjacent pipe covering, or one piece PVC cover sections as specified.

B. Foamed Plastic Insulation Installation (Return Suction Piping, Interior Condensate Drains, and Electric Water Cooler Drains):

1. Insulation shall be slipped on pipe without slitting. Butt joints shall be sealed with the manufacturer’s recommended adhesive.
2. Where slip-on techniques are not possible, the insulation shall be carefully slit and applied to the pipe. Seal joints with the manufacturer’s recommended adhesive.

3. Insulate valves and fittings with fabricated foamed plastic insulation, or one piece PVC cover sections as specified.
4. Provide mastic vapor barrier for chilled water service insulation for areas subject to conditions of 90 degrees F or 85 percent relative humidity or higher.

C. Cellular Glass Insulation Installation (Chilled Water Supply/Return):

1. Interior aboveground.

   a. Each length of insulation shall be secured with two wires. Insulation shall be applied with all joints fitted to eliminate voids. Voids shall be eliminated by refitting or replacing insulation. Do not fill voids with joint sealer.
   b. On any straight run over 40 feet, install an expansion joint consisting of a 2 inch wide section of foamed plastic. Finish over this section with glasfab and mastic.
   c. Finish concealed piping with factory installed white all purpose jacket, all joints and seams sealed with fire rated adhesive. Finish elbows and fittings with breather mastic reinforced with white open weave membrane with maximum mesh opening of 10 x 10 per inch.
   d. For exposed piping in machine rooms and similar spaces, finish with breather mastic reinforced with white open weave membrane with maximum mesh opening of 10 x 10 per inch. Then apply second coat of breather mastic and brush lightly with a wet brush to a smooth finish.

2. Exterior Aboveground:

   a. Same as interior aboveground.
   b. Finish with 0.016" aluminum jacket secured with 1/2" aluminum bands and seals, aluminum screws, or pop rivets on 9 inches on center. Elbows, valves, and fittings shall be finished with preformed aluminum fitting covers. Seam shall be placed at bottom. Caulk all joints to prevent water intrusion.

D. Flexible Fiberglass Ductwrap Blanket Insulation Installation:

1. Apply insulation to duct with joints tightly butted. Prepare stretch-out dimensions and cut out insulation so a 2 inch minimum overlap is created that will overlap the facing and insulation at the other end, and the adjoining seam. Install so insulation is not excessively compressed at duct edges. Foil face shall be on outside. Seams shall be stapled approximately at 6 inches on center with outward clinching staples.
2. On ductwork having a 24 inch or larger dimension, insulation shall be secured to the bottom of the duct with mechanical fasteners spaced at not more than 18 inches on center. and held in place with washers or clips. Cut off protruding pin after clips are secured.
3. Seal all insulation joints, pinheads, tears, punctures, washers, clips, and staples with 2 coats of a vapor barrier mastic type sealant, reinforced with 1 layer of 4 inch woven glass fabric.

E. Rigid Fiberglass Ductboard Insulation Installation:

1. Apply insulation tightly and smoothly to duct.
2. Secure insulation on the sides and bottom of duct by impaling insulation over pins or anchors located not more than 18 inches apart and held in place with washers or clips.
3. Cut off protruding pins after clips are secured and seal with vapor barrier mastic.
4. Apply insulation with joints tightly butted.
5. Seal ductwork joints, punctures, and pin heads with a vapor barrier mastic type sealant.
6. Insulation shall be continuous through walls and floors except at fire dampers and at

combination smoke/fire dampers.

7. Finish with field applied fab and mastic finish consisting of a 10 x 10 glass fabric imbedded in 2 coats of a white breather weather barrier mastic.

F.Equipment:

1. Chilled Water Pump Casings and Expansion Tanks:

   a. Insulate with not less than 2 inches of cellular glass block insulation finished with a 1/2" thick coat of insulating cement reinforced with 1 inch hexagonal mesh wire cloth, followed by a 1/2" thick coat of hard finish insulating cement.
   b. Apply casing insulation in 2 removable sections to ease pump maintenance.

G. Electric Duct Heaters:

1. Insulate all sides of electric duct heaters (except control panel side) installed in supply air ducts, as specified for supply air ductwork.

END OF SECTION

# SECTION 23 08 00 COMMISSIONING OF HVAC

## PART 1 - GENERAL

1.01 SUMMARY

A. See Section 01 91 13 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 91 13.

B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.

D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:

1. Control system.
2. Major and minor equipment items.
3. Piping systems and equipment.
4. Ductwork and accessories.
5. Terminal units.
6. Sound control devices.
7. Vibration control devices.
8. Variable frequency drives.
9. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

E. Indoor Air Quality Procedures: The Commissioning Authority will coordinate; Contractor will execute.

F. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 RELATED REQUIREMENTS

A. Section 01 57 21 - Indoor Air Quality Controls: Precautions and procedures; smoking room testing; building flush-out.

B. Section 01 78 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.

C. Section 01 91 13 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.

D. Section 23 09 00 – Controls and Instrumentation.

E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.03 SUBMITTALS

A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.

B. DRAFT Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:

1. System name.
2. List of devices.
3. Step-by-step procedures for testing each controller after installation, including:
   a. Process of verifying proper hardware and wiring installation.
   b. Process of downloading programs to local controllers and verifying that they are

addressed correctly.
c. Process of performing operational checks of each controlled component.
d. Plan and process for calibrating valve and damper actuators and all sensors.
e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.

4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has “passed” and is operating within the contract parameters.
5. Description of the instrumentation required for testing.
6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.

C. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.

D. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
2. Full as-built set of control drawings.
3. Full as-built sequence of operations for each piece of equipment.
4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
a. Floor.
b. Room number.
c. Room name.
d. Air handler unit ID.
e. Reference drawing number.
f. Air terminal unit tag ID.
g. Heating and/or cooling valve tag ID.
h. Minimum air flow rate.
i. Maximum air flow rate.
5. Full print out of all schedules and set points after testing and acceptance of the system.
6. Full as-built print out of software program.
7. Electronic copy on disk of the entire program for this facility.
8. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
9. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
10. Control equipment component submittals, parts lists, etc.
11. Warranty requirements.
12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
a. Sequences of operation.
b. Control drawings.
c. Points lists.

d. Controller and/or module data.
e. Thermostats and timers.
f. Sensors and DP switches.
g. Valves and valve actuators.
h. Dampers and damper actuators.
i. Program setups (software program printouts).

E. Project Record Documents: See Section 01 78 00 for additional requirements.
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.

F. Draft Training Plan: In addition to requirements specified in Section 01 79 00, include:
1. Follow the recommendations of ASHRAE Guideline 1.
2. Control system manufacturer's recommended training.
3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

G. Training Manuals: See Section 01 78 00 for additional requirements.
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

**PART 2 - PRODUCTS**

2.01 TEST EQUIPMENT

A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.

B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

**PART 3 – EXECUTION**

3.01 PREPARATION

A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.

B. Furnish additional information requested by the Commissioning Authority.

C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.

D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.

E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

G. Provide temperature and pressure taps in accordance with the contract documents.

3.02 INSPECTING AND TESTING - GENERAL

A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
C. Provide two-way radios for use during the testing.
D. Valve/Damper Stroke Setup and Check:
   1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
   2. Set pump/fan to normal operating mode.
   3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
   4. Command valve/damper open; verify position is full open and adjust output signal as required.
   5. Command valve/damper to a few intermediate positions.
   6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
E. Isolation Valve or System Valve Leak Check: For valves not by coils.
   1. With full pressure in the system, command valve closed.
   2. Use an ultra-sonic flow meter to detect flow or leakage.
F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION

A. TAB: Testing, adjusting, and balancing of HVAC.
B. Coordinate commissioning schedule with TAB schedule.
C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submittal.
B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with the contract documents.
C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
D. Functional Testing of the control system constitutes demonstration.
E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
   1. Setpoint changing features and functions.
   2. Sensor calibrations.
G. Demonstrate to the Commissioning Authority:
   1. That all specified functions and features are set up, debugged and fully operable.
   2. That scheduling features are fully functional and setup, including holidays.

3. That all graphic screens and value readouts are completed.
4. Correct date and time setting in central computer.
5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
7. Power failure and battery backup and power-up restart functions.
8. Global commands features.
9. Security and access codes.
10. Occupant over-rides (manual, telephone, key, keypad, etc.).
11. O&M schedules and alarms.
12. Occupancy sensors and controls.
13. All control strategies and sequences not tested during controlled equipment testing.

H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS

A. See Section 01 78 00 for additional requirements.
B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING

A. See Section 01 79 00 for additional requirements.
B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
   1. HVAC Control System: 2 hours.
   2. Air Handling Units: 1 hours.
   3. Variable Speed Drives: 1 hours.
   4. Air Terminal Units: 1 hours.
   5. Split System AC or Heat Pumps: 1 hours.
E. TAB Review: Instruct Owner's personnel for minimum 2 hours, after completion of TAB, on the following:
   1. Review final TAB report, explaining the layout and meanings of each data type.
   2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
   3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
   4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.

5. Other salient information that may be useful for facility operations, relative to TAB.

F. HVAC Control System Training: Perform training in at least three phases:
   1. Phase 1 - Basic Control System: Provide minimum of 2 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
      a. This training may be held on-site or at the manufacturer's facility.
      b. If held off-site, the training may occur prior to final completion of the system installation.
      c. For off-site training, Contractor shall pay expenses of up to two attendees.
   2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 2 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
      a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
      b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
      c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
      d. Every display screen, allowing time for questions.
      e. Point database entry and modifications.
   3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 2 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.

G. Provide the services of manufacturer representatives to assist instructors where necessary.

H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

# SECTION 230900 CONTROLS AND INSTRUMENTATION

## PART 1 - GENERAL

1.1 SUMMARY

A. Related Sections:

1. 15855 – Air Handing Units.
2. 15515 – Valves, Hangers and Specialties.
3. 15590 - Tests.

1.2 SUBMITTALS

A. Provide complete operating data, system drawings, wiring diagrams, and written detailed operation description of sequences and description and engineering data on each control system component before starting work.

1. Include sizing as requested.
2. Include manufacturer's installation instructions.

B. Shop Drawings: Submit composite shop drawings including electric control diagram.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Controls and Instrumentation:

1. Barber-Coleman.
2. Johnson Controls.
3. Seimens.
4. Trane.
5. Delta

2.2 SYSTEM REQUIREMENTS

A. Provide control systems consisting of thermostats, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified.

B. Provide materials and field work necessary to connect control components factory supplied as part of equipment controlled, unless specified otherwise.

1. Generally, self-contained valves, filter gages, liquid level controllers, and similar instruments shall not to be installed under this section.

C. Unless specified otherwise, provide fully proportional components.

2.3 EQUIPMENT

A. Bulb Thermostat:

1. 2 position, 2 stage controller.
2. Liquid filled thermal element shall actuate 1 snap action SPDT switch per stage for two stages.

a. Controller shall allow mounting in any position and shall operate with an ambient temperature range of -40 to 140 degrees F.
b. Maximum safe bulb temperature shall be 50 degrees F. above scale range.
c. Controller shall be furnished with liquid filled thermal element, capillary tube, and bulb well for mounting in pipe.

B. Miscellaneous Devices: Provide necessary relays, cumulators, 3-way air valves, positions, pneumatic electric switches, solenoid valves, switches, relays, clocks, transformers, etc., to make a complete and operable system.

C. Control Enclosures:

1. Provide enclosures of unitized cabinet type for each system under automatic control.

a. Mount relays, switches, and controllers with control point adjustment in the enclosure and temperature indicators, pressure gages, pilot lights, push buttons, clocks and switches flush on enclosure panel face.

2. Fabricate enclosures from 12 gage steel with baked enamel finish and hinged key lock door.
3. Mount enclosure next to associated equipment on vibration free walls or free standing steel angle supports.

a. 1 enclosure may hold more than 1 system in the same equipment room.
b. Provide engraved plastic nameplates for instruments and controls inside the enclosure and on the enclosure face.

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Check and verify location of exposed control sensors with plans and room details before installation.
B. At completion of work, submit test report automatic control system.
C. Provide control diagrams for each system, framed under glass for wall mounting.

END OF SECTION

# SECTION 232300 REFRIGERANT PIPING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

### 1.2 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Field quality-control test reports.

D. Operation and maintenance data.

### 1.3 QUALITY ASSURANCE

A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

### 1.4 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

## PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
8. Working Pressure Rating: 500 psig (3450 kPa).
9. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and [24] [115] [208]-V ac coil.
6. Working Pressure Rating: 400 psig (2760 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig (2760 kPa).
6. Maximum Operating Temperature: 240 deg F (116 deg C).

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F (4.4 deg C).
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).

8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig (4820 kPa) or 450 psig (3100 kPa).

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 deg F (135 deg C).

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 deg F (135 deg C).

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 deg F (116 deg C).

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Rated Flow:
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 deg F (116 deg C).

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina or charcoal.

4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig (14 kPa).
8. Rated Flow:
9. Working Pressure Rating: 500 psig (3450 kPa).
10. Maximum Operating Temperature: 240 deg F (116 deg C).

2.3 REFRIGERANTS

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. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

C. ASHRAE 34, R-410a Pentafluoroethane/Pifluoromethane.

**PART 3 - EXECUTION**

3.1 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with soldered joints.

D. Hot-Gas and Liquid Lines:

1. NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
2. NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

E. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, K (A), L (B), drawn-temper tubing and wrought-copper fittings with soldered joints.

F. Safety-Relief-Valve Discharge Piping:

1. NPS 1-1/2 (DN 40) and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at strainers if they are not an integral part of strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Division 23 Sections 23 09 00 Controls and Instrumentation and Contract Documents.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

## 3.4 PIPE JOINT CONSTRUCTION

A. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

B. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

## 3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).

4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

D. Support multifloor vertical runs at least at each floor.

## 3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

## 3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
4. Charge system with a new filter-dryer core in charging line.

## 3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 232300

# SECTION 233113 METAL DUCTS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes metal, rectangular ducts and fittings for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg (minus 500 to plus 2500 Pa).

B. See Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.

C. See Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

### 1.2 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal ducts.

1. Penetrations through fire-rated and other partitions.
2. Duct accessories, including access doors and panels.

### 1.3 QUALITY ASSURANCE

A. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 SHEET METAL MATERIALS

A. 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.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

D. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

## 2.3 SEALANT MATERIALS

A. Joint and Seam Tape: 2 inches (50 mm) wide; glass-fiber-reinforced fabric.

B. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

C. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

## 2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Galvanized-steel shapes and plates complying with ASTM A 36/A 36M.

## 2.5 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Nexus Inc.
c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Manufacturers:

a. Ductmate Industries, Inc.
b. Lockformer.

2. Duct Size: Maximum 30 inches (750 mm) wide and up to 2-inch wg (500-Pa) pressure class.
3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches (480 mm) and larger and 0.0359 inch (0.9 mm) thick or less, with more than 10 sq. ft. (0.93 sq. m) of nonbraced panel area unless ducts are lined.

## PART 3 - EXECUTION

### 3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts: 2-inch wg (500 Pa).
2. Supply Ducts (before Air Terminal Units): 2-inch wg (500 Pa).
3. Supply Ducts (after Air Terminal Units): 1-inch wg (250 Pa).
4. Supply Ducts (in Mechanical Equipment Rooms): 2-inch wg (500 Pa).
5. Return Ducts (Negative Pressure): 1-inch wg (250 Pa).
6. Exhaust Ducts (Negative Pressure): 1-inch wg (250 Pa).

### 3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install ducts with fewest possible joints.

C. Install fabricated fittings for changes in directions, size, and shape and for connections.

D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches (300 mm), with a minimum of 3 screws in each coupling.

E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

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 (25 mm), plus allowance for insulation thickness.

H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

K. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches (38 mm).

M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Air Duct Accessories." Firestopping materials and installation methods are specified in Division 07 Section "Penetration Firestopping."

N. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

## 3.3 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg (500 Pa), seal transverse joints.

B. Seal ducts before external insulation is applied.

## 3.4 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches (600 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet (5 m) and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

## 3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION 233113

# SECTION 233300 AIR DUCT ACCESSORIES

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke dampers.
6. Flange connectors.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

1.2 SUBMITTALS

A. LEED Submittals:

1. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1-2007, Section 5 – “Systems and Equipment”.

B. Product Data: For each type of product indicated.

C. 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. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
e. Wiring Diagrams: For power, signal, and control wiring.

D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

**PART 2 - PRODUCTS**

2.1 MATERIALS

A. 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.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Duro Dyne Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 1-inch wg (0.25 kPa).

E. Frame: 0.052-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum or 0.050-inch- (1.2-mm-) thick aluminum sheet with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel.
2. Diameter: 0.20 inch (5 mm).

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Front of rear screens.
6. 90-degree stops.

N. Sleeve: Minimum 20-gage (1.0-mm) thickness.

## 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. McGill AirFlow LLC.
   b. METALAIRE, Inc.
   c. Air Balance, Inc.; a Division of Mestek, Inc.
   d. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple.
b. Parallel.
c. Stiffen damper blades for stability.
d. Galvanized-steel, 0.064 inch (1.62 mm) thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

a. Oil-impregnated bronze.
b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axle's full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

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

a. Air Balance Inc.; a division of Mestek, Inc.
b. McGill AirFlow LLC.
c. Nailor Industries Inc.
d. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with 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. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

6. Blade Axles: Galvanized steel.
7. Bearings:

a. Oil-impregnated bronze.
b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axle's full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

C. Jackshaft:

1. Size: 1-inch (25-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

## 2.4 CONTROL DAMPERS

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

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Ruskin Company.
4. Young Regulator Company.

B. Frames:

1. Hat shaped.
2. Galvanized-steel channels, 0.064 inch (1.62 mm) thick.
3. Mitered and welded corners.

C. Blades:

1. Multiple blade with maximum blade width of 8 inches (200 mm).
2. Opposed-blade design.
3. Galvanized steel.
4. 0.064 inch (1.62 mm) thick.
5. Blade Edging: Closed-cell neoprene edging.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

D. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

E. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axle's full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.5 FIRE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Greenheck Fan Corporation.
3. McGill AirFlow LLC.
4. Nailor Industries Inc.
5. Ruskin Company.
6. Vent Products Company, Inc.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

K. Heat-Responsive Device: Replaceable link and switch package, factory installed, 165 deg F (74 deg C) rated.

2.6 SMOKE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

F. Leakage: Class I.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

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.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Division 23 Section 23 09 00 – Controls and Instrumentation.
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for signaling, fan control or position indication.
2. Momentary test switch or Test and reset switches, damper or remote mounted.

## 2.7 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

## 2.8 TURNING VANES

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. SEMCO Incorporated.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Turning Vanes for Metal Ducts: 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. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

## 2.9 DUCT-MOUNTED ACCESS DOORS

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

1. Ductmate Industries, Inc.
2. Ruskin Company
3. Greenheck Fan Corporation.
4. McGill AirFlow LLC.
5. Nailor Industries Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

## 2.10 DUCT ACCESS PANEL ASSEMBLIES

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

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0428-inch (1.1-mm) stainless steel.

D. Fasteners: Stainless 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 (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

## 2.11 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.

4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. 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. Outdoor 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 (6-mm) movement at start and stop.

## 2.12 FLEXIBLE DUCTS

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

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).

C. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
2. Non-Clamp Connectors: Adhesive or Liquid adhesive plus tape.

2.13 DUCT ACCESSORY HARDWARE

A. 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.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," 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. 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.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

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. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.
3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors; and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
4. At each change in direction and at maximum 50-foot (15-m) spacing.
5. Upstream of turning vanes.
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 (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors according to Division 23 Section 23 05 53 -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-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect terminal units to supply ducts directly or with maximum 12-inch (300-mm) lengths of flexible duct. Do not use flexible ducts to change directions.

O. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

R. 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 (6-mm) 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 purpose of access door can be performed.
3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

# SECTION 233423 HVAC POWER VENTILATORS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes the following:

1. Centrifugal roof ventilators.
2. Ceiling-mounting ventilators.
3. In-line centrifugal fans.

### 1.2 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Field quality-control test reports.

D. Operation and maintenance data.

### 1.3 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. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

C. UL Standard: Power ventilators shall comply with UL 705.

## PART 2 - PRODUCTS

### 2.1 CENTRIFUGAL ROOF VENTILATORS

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:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Carnes Company HVAC.
2. Greenheck.
3. Loren Cook Company.
4. Penn Ventilator

D. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

E. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

F. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

G. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

H. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
3. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

I. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Built-in raised cant and mounting flange.
2. Overall Height: 8 inches (200 mm, 9-1/2 inches (240 mm), 12 inches (300 mm), 16 inches (400 mm) or 18 inches (450 mm).
3. Sound Curb: Curb with sound-absorbing insulation matrix.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Burglar Bars: 1/2-inch- (13-mm-), 5/8-inch- (16-mm-) or 3/4-inch- (19-mm-) thick steel bars welded in place to form 6-inch (150-mm) squares.
7. Mounting Pedestal: Galvanized steel with removable access panel.
8. Vented Curb: Unlined with louvered vents in vertical sides.

2.2 CEILING-MOUNTING VENTILATORS

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:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Carnes Company HVAC.
2. Greenheck.
3. Loren Cook Company.
4. NuTone Inc.

D. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

E. Housing: Steel, lined with acoustical insulation.

F. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

G. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

H. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

I. Accessories:

1. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
2. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
3. Motion Sensor: Motion detector with adjustable shutoff timer.
4. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
5. Filter: Washable aluminum to fit between fan and grille.
6. Isolation: Rubber-in-shear vibration isolators.
7. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.3 IN-LINE CENTRIFUGAL FANS

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:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Carnes Company HVAC.
2. Greenheck.

3. Loren Cook Company.
4. Penn Ventilation.

D. Description: In-line, direct, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

E. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

F. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing; with wheel, inlet cone, and motor on swing-out service door.

G. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

H. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

I. Accessories:

1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

2.4 MOTORS

A. Comply with requirements in Section 23 05 13 - Common Motor Requirements for HVAC Equipment.

B. Enclosure Type: Totally enclosed, fan cooled.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 - Cast-in-Place Concrete.

D. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Division 23 Section 23 05 53 - Identification for HVAC Piping and Equipment.

I. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section 23 33 00 - Air Duct Accessories.

J. Install ducts adjacent to power ventilators to allow service and maintenance.

K. Ground equipment according to Division 26 Section 26 05 26 - Grounding and Bonding for Electrical Systems.

L. Connect wiring according to Division 26 Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

## 3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 233423

# SECTION 233713 DIFFUSERS, REGISTERS, AND GRILLES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

### 1.2 SUBMITTALS

A. Product Data: For each product indicated, include the following:

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, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 GRILLES AND REGISTERS

A. Adjustable Bar Grille and Register:

1. Manufacturers:

a. Carnes.
b. Air Guide
c. Price Industries.
d. Titus.

2. Material: Aluminum.

3. Finish: Baked enamel, white.
4. Face Blade Arrangement: Fixed horizontal, adjustable vertical spaced 1/2 inch (13 mm) apart.
5. Rear Blade Arrangement: Fixed horizontal,adjustable vertical spaced 1/2 inch (13 mm) apart.
6. Frame: 1 inch (25 mm) wide.
7. Mounting Frame: as indicated in the drawing.
8. Mounting: Lay in.
9. Damper Type: Adjustable opposed-blade assembly.
10. Accessories: Rear-blade gang operator.

B. Fixed Face Grille or Register:

1. Manufacturers:
   a. Carnes.
   b. Air Guide
   c. Price Industries.
   d. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch (13-by-13-by-13-mm) grid core.
5. Frame: 1 inch (25 mm) wide.
6. Mounting Frame: as indicated on drawings.
7. Mounting: Lay in.
8. Damper Type: Adjustable opposed-blade assembly.

## 2.3 CEILING DIFFUSER OUTLETS

A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers:

   a. Carnes.
   b. Air Guide
   c. Price Industries.
   d. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Size: 24 by 24 inches (600 by 600 mm).
5. Face Style: Four cone.
6. Mounting: T-bar, Snap in, Spline as indicated on drawings.
7. Pattern: Fixed, Two position or Adjustable.
8. Dampers: Radial opposed blade.
9. Accessories:

   a. Equaling grid.
   b. Plaster ring.
   c. Safety chain.
   d. Wire guard.
   e. Sectorizing baffles.

f. Operating rod extension.

B. Louver Face Diffuser:

1. Manufacturers:

a. Carnes.
b. Air Guide
c. Price Industries.
d. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Size: See Drawings.
5. Mounting: T-bar, Snap in, Spline or as indicated on Drawings.
6. Pattern: One-way core style.
7. Dampers: Radial opposed.
8. Accessories:

a. Square to round neck adaptor.
b. Adjustable pattern vanes.
c. Throw reducing vanes.
d. Equaling grid.
e. Plaster ring.
f. Safety chain.
g. Wire guard.
h. Sectorizing baffles.
i. Operating rod extension.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

## PART 3 - EXECUTION

3.1 INSTALLATION

A. Install diffusers, registers, and grilles 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 practicable. 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, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

# SECTION 238126 SPLIT-SYSTEM AIR-CONDITIONERS

## PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.2 SUBMITTALS

A. Product Data: For each unit indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Operation and maintenance data.

1.3 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. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

C. Coefficient of Performance: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

D. Units shall be designed to operate with HCFC-free refrigerants.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace split-system air-conditioning units that fail in materials and workmanship within five (5) years from date of Substantial Completion.

## PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

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

1. Carrier Air Conditioning; Div. of Carrier Corp.

2. Lennox Industries Inc.

3. Trane Co. (The); Unitary Products Group.

4. York International Corp.

5. McQuay

2.2 AIR HANDLING UNIT

A. Factory assembled and pre-wired draw-thru type air handling unit suitable for low or medium pressure operation and consisting of a fan section, coil section, filter section and accessories.

B. Factory test air handling units of size, capacities and configuration as indicated and specified.

C. Base air handling unit performance on sea level conditions.

D. Construct casing heavy gauge, double-wall galvanized steel on channel base. Casing to be constructed and reinforced to withstand the maximum fan pressures developed. Fabricated channel base of galvanized welded steel.

E. 1. Casing shall include insulated, hinged, double wall access doors in the filter, fan and coil sections.

F. 2. Insulate casing sections with 1 inch thick/3 PCF density or 2 inch thick/ 1.5 PCF uncompressed insulation sandwiched between the outer milled galvanized steel wall and the inner galvanized steel wall. Minimum insulation R-value of 4.2.

G. 3. Construct drain pan from insulated, double wall stainless steel with welded corners and a bottom drain. Pitch entire pan to drain connection.

H. 4. The manufacturer shall be responsible for providing additional rigid board type insulation to prevent the air handling unit from sweating under the encountered operating conditions.

I. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal expansion valve.

J. Fan: Forward-curved, double-width wheel of galvanized steel. Provide motor and fan with internal vibration isolators.

K. Filters:

L. 1. Provide flat type filter section constructed of galvanized steel and containing filter guides and hinged access doors on both sides for side loading of filters.

M. 2. Construction Filter: Provide two sets of temporary 2 inch thick fiberglass throw away filters use during construction and start up. Construction filters to be 45% efficient. Construction filters shall be provided for all filter application. Replace filter regularly but do not exceed 7 days during construction. Final Filter: Shall consist of a single 2 inch thick, disposable, pleated particulate filter, ASHRAE standard 52.1-92 rated at 40-45% atmospheric dust spot efficiency (Ads), located in filter box upstream of each coil.

N. 3. Provide an analog differential pressure gauge across the filter to monitor dirty filter conditions.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER UNIT

A. Casing steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed reciprocating or scroll type with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1. Refrigerant Charge: R-410.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Fan: Aluminum-propeller type, directly connected to motor.

E. Motor: Permanently lubricated, with integral thermal-overload protection.

F. Mounting Base: Polyethylene.

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Install air handling unit components using manufacturer's standard mounting devices securely fastened to building structure.

B. Install roof mounted, compressor-condenser components (see detail drawing).

3.2 CONNECTIONS

A. Connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 238126

## SECTION 260519 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

## PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Fire-alarm wire and cable.
3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 260513 "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 601 to 35,000 V.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
3. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

## PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.

3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.

## 2.2 FIRE-ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair size as recommended by system manufacturer.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

## 2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper
2. Type: One hole with standard barrels.
3. Termination: Compression; Crimp.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Feeders: Copper for feeders smaller than No. 4 AWG; copper for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

E. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

E. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRING

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 280528 "Pathways for Electronic Safety and Security."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire-alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

G. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.

H. Wiring to Remote Alarm Transmitting Device: 1-inch (25-mm) conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

## 3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

D. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

## 3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

## 3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

## 3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

END OF SECTION 260519

# SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: 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.

### 1.3 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, AWS D1.2/D1.2M.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. 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 1-5/8 inches (41.25 mm)
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. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs 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. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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 (Grade A325M).
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.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

**PART 3 - EXECUTION**

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by, scheduled in NECA 1, where its Table 1 lists maximum spacings that are less than those stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69, Spring-tension clamps.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

## 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

END OF SECTION 260529

# SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 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.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

### 1.3 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.

## PART 2 - PRODUCTS

### 2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. Retain "ARC" Paragraph below for corrosion resistance and for power distribution at frequencies above 60 Hz or for other special conditions.
4. IMC: Comply with ANSI C80.6 and UL 1242.
5. EMT: Comply with ANSI C80.3 and UL 797.
6. In "FMC" Paragraph below, zinc-coated steel is most common type and provides some additional protection from physical damage. Aluminum is much lighter and easier to install.
7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings: Comply with NEMA FB 1 and UL 514B.

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Coordinate "Conduit Fittings for Hazardous (Classified) Locations" Subparagraph below with Drawings.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:

    a. Material: Steel.
    b. Type: Setscrew or compression.

6. 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.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

### 2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

B. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. ENT: Comply with NEMA TC 13 and UL 1653.

2. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.
3. LFNC: Comply with UL 1660.

C. Nonmetallic Fittings:

1. Fittings, General: Listed and labeled for type of conduit, location, and use.
2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
3. Fittings for LFNC: Comply with UL 514B.
4. 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, Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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.

## 2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

D. Solvents and Adhesives: As recommended by conduit manufacturer.

## 2.5 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. Metal Floor Boxes:

1. Material: sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

E. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb (32 kg).

1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

H. Device Box Dimensions: 4 inches square by 2-1/2 inches deep (100 mm square by 60 mm deep) 4 inches by 4 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep)

I. Gangable boxes are allowed.

J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. Cabinets:

1. NEMA 250, Type 1, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with closed 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."
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

**PART 3 - EXECUTION**

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC, IMC.
2. Concealed Conduit, Aboveground: GRC, IMC, EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated.

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC, IMC. Raceway locations include the following:

    a. Loading dock.
    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    c. Mechanical rooms.
    d. Gymnasiums.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC, IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (16-mm) trade size for homeruns

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

## 3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

F. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches (300 mm) of enclosures to which attached.

L. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from PVC to GRC before rising above floor.

M. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
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 raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Q. 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 (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. 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.

U. 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.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
    d. Attics: 135 deg F (75 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F (0.06 mm per meter of length of straight run per degree C) of temperature change for PVC 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.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. 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.

Y. 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 the box and cover plate or the supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

## 3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

## 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, <Insert depth of frost line below grade at Project site> below grade.

E. 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 SUMMARY

A. Section Includes:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Duct accessories.
5. Precast concrete handholes.
6. Polymer concrete handholes and boxes with polymer concrete cover.
7. Fiberglass handholes and boxes with polymer concrete cover.
8. Fiberglass handholes and boxes.
9. High density plastic boxes.
10. Precast manholes.
11. Utility structure accessories.

### 1.2 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.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:

a. Include plans, elevations, sections, details, attachments to other work, and accessories.
b. Include duct entry provisions, including locations and duct sizes.
c. Include reinforcement details.
d. Include frame and cover design and manhole chimneys.

e. Include ladder step details.
f. Include grounding details.
g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
h. Include joint details.

2. 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.
e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.4 INFORMATIONAL SUBMITTALS

A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures. Drawings shall be signed and sealed by a qualified professional engineer.

B. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.

C. Product Certificates: For concrete and steel used in precast concrete manholes, as required by ASTM C858.

D. Source quality-control reports.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

**PART 2 - PRODUCTS**

2.1 METAL CONDUIT AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6.

B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

## 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 nationally recognized testing laboratory, 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."

## 2.4 PRECAST CONCRETE HANDHOLES AND BOXES

A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

B. Comply with ASTM C858 for design and manufacturing processes.

C. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

D. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.

E. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

F. Cover Legend: Molded lettering, "ELECTRIC."

G. Configuration: Units shall be designed for flush burial and have closed bottom unless otherwise indicated.

H. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

1. Extension shall provide increased depth of 12 inches (300 mm).
2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.

I. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

J. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

K. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

L. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.5 PRECAST MANHOLES

A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.

B. Comply with ASTM C858.

C. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.

D. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.

E. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.

F. Ground Rod Sleeve: Provide a 3-inch (75-mm) PVC sleeve in manhole floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the duct entering the structure.

G. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

## 2.6 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes 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 an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 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 Architect 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 manholes and handholes, and as approved by Architect.

### 3.2 UNDERGROUND DUCT APPLICATION

A. Duct for Electrical Feeders 600 V and Less: RNC Type EPC-40-PVC, concrete-encased unless otherwise indicated.

B. Duct for Electrical Feeders 600 V and Less: RNC Type EPC-40-PVC, concrete-encased unless otherwise indicated.

C. Duct for Electrical Branch Circuits: RNC Type EPC-40-PVC, concrete-encased unless otherwise indicated.

D. Bored Underground Duct: Type EPEC-40 HDPE unless otherwise indicated.

E. Underground Ducts Crossing Paved Paths, Walks, and Driveways: RNC Type EPC-40 PVC, encased in reinforced concrete.

F. 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: Precast concrete. AASHTO HB 17, H-10 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Cover design load shall not exceed the design load of the handhole or box.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

## 3.4 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. 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."

D. 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, 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 manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.

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 (1200 mm), both horizontally and vertically, at other locations unless otherwise indicated.

1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 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. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) duct, and vary proportionately for other duct sizes.

H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches (150 mm) o.c. for 4-inch (100-mm) duct, and vary proportionately for other duct sizes.

I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet (3 m) 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."

J. 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 (1.03-MPa) hydrostatic pressure.

K. Pulling Cord: Install 200-lbf- (1000-N-) test nylon cord in empty ducts.

L. Concrete-Encased Ducts and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
4. Depth: Install so top of duct envelope is at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
5. Support duct 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 (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) 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.
7. Minimum Space between Duct: 3 inches (75 mm) between edge of duct and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and communications ducts.
8. 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.
9. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
10. 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.
11. 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.

12. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover between edge of duct to exterior envelope wall, 2 inches (50 mm) between duct of like services, and 4 inches (100 mm) between power and communications ducts.
13. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place 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.

M. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 12 inches (300 mm) wider than duct on each side.
3. Width: Excavate trench 3 inches (75 mm) wider than duct on each side.
4. Depth: Install top of duct at least 36 inches (900 mm) below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than four spacers per 20 feet (6 m) of duct. Place spacers within 24 inches (600 mm) of duct ends. Stagger spacers approximately 6 inches (150 mm) 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.
8. Install duct with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and communications duct.
9. 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.
10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
11. 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 (100 mm) 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 (75 mm) of sand as a bed for duct. Place sand to a minimum of 6 inches (150 mm) above top level of duct.
    b. Place minimum 6 inches (150 mm) of engineered fill above concrete encasement of duct.

N. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches (300 mm) above all concrete-encased duct and duct banks and approximately 12 inches (300 mm) below grade. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

## 3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches (375 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below frost line, <Insert depth of frost line below grade at Project site> below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Section 071353 "Elastomeric Sheet Waterproofing." After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Bituminous Dampproofing." After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.

G. Hardware: 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.

H. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

I. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

## 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- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
3. Test manhole and 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. Round sleeves.
2. Rectangular sleeves.
3. Sleeve seal systems.
4. Grout.
5. Pourable sealants.
6. Foam sealants.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

## PART 2 - PRODUCTS

### 2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Sheet Metal Sleeves, Galvanized Steel, Round:

1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch (0.6-mm); round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:

a. Material: Galvanized sheet steel.
b. Minimum Metal Thickness:

1) For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness must be 0.052 inch (1.3 mm).
2) For sleeve cross-section rectangle perimeter not less than 50 inches (1270 mm) or with one or more sides larger than 16 inches (400 mm), thickness must be 0.138 inch (3.5 mm).

2.3 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and 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: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.5 POURABLE SEALANTS

A. Description: Single-component, 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.

2.6 FOAM SEALANTS

A. Description: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

**PART 3 - EXECUTION**

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. 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 space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. 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."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

F. Underground, Exterior-Wall and Floor Penetrations:

1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.

2. Install steel pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

## 3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

## 3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

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.

END OF SECTION 26 05 44

# 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.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. 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.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
2. Colors for 208/120-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.

3. Colors for 240-V Circuits:

a. Phase A: Black.
b. Phase B: Red.

4. Colors for 480/277-V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.

5. Color for Neutral: White or gray.
6. Color for Equipment Grounds: Green.
7. Colors for Isolated Grounds: Green two or more yellow stripes.

C. Warning Label Colors:

1. Identify system voltage with black letters on a black background.

D. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

E. Equipment Identification Labels:

1. Black letters on a white field.

2. Panelboard, disconnects, transformers, lighting contracotrs

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 diameter and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, 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: Permanent, waterproof, black ink marker recommended by tag manufacturer.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

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".

E. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.

c. Engraved legend with black letters on white face.

2.4 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 (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.5 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 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. 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.

H. 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.

I. 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.

J. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

L. sizes of labels, signs, and letters to those appropriate for viewing from the floor.

M. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

N. Vinyl Wraparound Labels:

1. Secure tight to surface 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 Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

Q. Self-Adhesive Labels:

1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

R. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

S. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

T. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

U. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

V. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

W. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

X. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope ]exceeds 16 inches (400 mm) overall.
2. Limit use of underground-line warning tape to direct-buried cables.
3. Install underground-line warning tape for direct-buried cables and cables in raceways.

Y. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using general-purpose 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- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

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- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

BB. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

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.

3.2 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 120 V to Ground: Identify with self-adhesive vinyl tape applied in bands.

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."
3. "UPS."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive wraparound labels with the conductor designation.

H. Auxiliary Electrical Systems Conductor Identification: Marker 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.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

J. Workspace Indication: Apply floor marking tape or tape and stencil 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.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive equipment 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.

M. Arc Flash Warning Labeling: Self-adhesive labels.

N. Operating Instruction Signs: Self-adhesive labels.

O. Emergency Operating Instruction Signs: Self-adhesive labels with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

P. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 260553

# SECTION 260923 – LIGHTING CONTROL DEVICES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:
1. Standalone daylight-harvesting switching and dimming controls.
2. Indoor occupancy and vacancy sensors.
3. Switchbox-mounted occupancy and vacancy sensors
4. Digital timer light switches.
5. High-bay occupancy and vacancy sensors.
6. Lighting contactors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors.
b. Vacancy sensors.

2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

### 1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

C. Sample warranty.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Software and firmware operational documentation.

1.5 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. Warranty Period: Two year(s) from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 TIME SWITCHES

A. Acuity Brands

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST
3. Contact Rating: 30-A inductive or resistive, 480-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
5. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
6. Programs: 32 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
7. Programs: 32 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule with a skip-a-day weekly schedule.
8. Programs: 32 channels; each channel is individually programmable with two on-off set points on a 24-hour schedule, allowing different set points for each day of the week.
9. Programs: 32 channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
10. Programs: 32 channels; each channel is individually programmable with 40 on-off operations per week, plus four seasonal schedules that modify the basic program and an annual holiday schedule that overrides the weekly operation on holidays.
11. Programs: 32 channels and an annual holiday schedule that overrides the weekly operation on holidays.
12. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
13. Astronomic Time: Selected channels.
14. Automatic daylight savings time changeover.
15. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Acuity Brands

B. General Requirements for Sensors:

1. Ceiling mounted, solid-state indoor occupancy and vacancy sensors.
2. Passive infrared, Ultrasonic, Dual technology.
3. Integrated, Separate power pack.
4. Hardwired connection to switch; and BAS and lighting control system.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:

    a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    b. 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.
    c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
8. Power: Line voltage
9. 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.
10. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room, Ceiling Mounted): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

3. Detection Coverage (Corridor, Ceiling Mounted): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) 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 (110 square meters) when mounted 48 inches (1200 mm) above finished floor.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
6. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet (110 square meters) when mounted84 inches (2100 mm) above finished floor.

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) 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 (110 square meters) mounted48 inches (1200 mm) above finished floor.

## 2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Acuity Brands

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).
4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type:SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Dual voltage - 120 and 277 V.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: White
11. Faceplate: Color matched to switch.

D. Wall-Switch Sensor Tag WS2:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: PIR.
3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
4. Capable of controlling load in three-way application.
5. Voltage: Dual voltage, 120 and 277 V.
6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
10. Color: White
11. Faceplate: Color matched to switch.

## 2.4 DIGITAL TIMER LIGHT SWITCH

A. Acuity Brands

B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10 minute increments.

1. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 amps at 277-V ac for LED, and 1/4 horsepower at 120-V ac.
2. Integral relay for connection to BAS.
3. Voltage: Dual voltage - 120 and 277 V].

4. Color: White
5. Faceplate: Color matched to switch.

2.5 LIGHTING CONTACTORS

A. Description: Electrically operated and mechanically held, combination-type lighting contactors with an HOA switch complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices matching the NEMA type specified for the enclosure.

2.6 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

**PART 3 - EXECUTION**

3.1 INSTALLATION

A. Comply with NECA 1.

B. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

C. 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.

D. 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.

E. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

## 3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

## 3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

B. Label time switches and contactors with a unique designation.

## 3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

## 3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

## 3.6 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

## 3.7 DEMONSTRATION

A. 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 262416 – PANELBOARDS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

### 1.2 DEFINITIONS

A. MCCB: Molded-case circuit breaker.

B. SPD: Surge protective device.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for SPD as installed in panelboard.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Key interlock scheme drawing and sequence of operations.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

### 1.4 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

### 1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 FIELD CONDITIONS

A. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 PANELBOARDS COMMON 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. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Flush and Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1
b. Outdoor Locations: NEMA 250, Type 3R
c. Kitchen / Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4
e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5

2. Height: 84 inches (2.13 m) maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

E. Incoming Mains Location: Top and Bottom.

F. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

G. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

H. NRTL Label: Panelboards shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

I. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

J. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

## 2.2 POWER PANELBOARDS

A. Manufacturers: Square D, Eaton, Siemens.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker, Lugs only.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

G. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. External Control-Power Source: 277-V branch circuit, 120-V control circuit.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Square D, Eaton, Siemens, GE

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. External Control-Power Source: 277-V branch circuit, 120-V control circuit.

F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Square D, Eaton, Siemens, GE.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.
b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
    h. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
    j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

## 2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted metal frame with transparent protective cover.

## 2.6 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NECA 407 Retain first paragraph below if seismic controls are required for Project. Coordinate with Drawings.

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box.

E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. 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.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

### 3.2 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; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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. 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.

END OF SECTION 262416

# SECTION 262726 – WIRING DEVICES

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. USB receptacles.
3. GFCI receptacles, 125 V, 20 A.
4. Toggle switches, 120/277 V, 20 A.
5. Decorator-style devices, 20 A.
6. Occupancy sensors.
7. Digital timer light switches.
8. Residential devices.
9. Wall-box dimmers.
10. Wall plates.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

### 1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Essential Electrical System: Red
3. SPD Devices: Blue.
4. Isolated-Ground Receptacles: Orange, as specified above, with orange triangle on face.

F. Wall Plate Color: For plastic covers, match device color.

G. 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. Hubbell, Leviton, Legrand
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A

1. Hubbell, Leviton, Legrand
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A

1. Hubbell, Leviton, Legrand
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A <Insert drawing designation>:

1. Hubbell, Leviton, Legrand

2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

## 2.3 USB RECEPTACLES

A. USB Charging Receptacles

1. Hubbell, Leviton, Legrand
2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 1310 and USB 3.0 devices.

B. Tamper-Resistant Duplex and USB Charging Receptacles

1. Hubbell, Leviton, Legrand
2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
3. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

## 2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A <Insert drawing designation>:

1. Hubbell, Leviton, Legrand
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A

1. Hubbell, Leviton, Legrand
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A

1. Hubbell, Leviton, Legrand
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Type: Feed through.
5. Standards: Comply with UL 498 and UL 943 Class A.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

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. Lighted Single-Pole Switches, 120/277 V, 20 A

1. Description: Handle illuminated when switch is on.

2.6 OCCUPANCY 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 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
4. Adjustable time delay of 20 minutes.
5. Able to be locked to Automatic-On mode.
6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux).
7. Connections: Provisions for connection to BAS.
8. Connections: RJ-45 communications outlet.
9. Connections: Integral wireless networking.

2.7 TIMER LIGHT SWITCH

A. Digital Timer Light Switch

1. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 10, 20-minute increments.
2. Standards: Comply with UL 20.
3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
4. Integral relay for connection to BAS.

2.8 DIMMERS

A. Wall-Box Dimmers:

1. As per Lighting Control drawings.

2.9 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, 0.035-inch- (1-mm-) thick, satin-finished.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, thermoplastic with lockable cover.

**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. 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.
2. 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.
3. Install wiring devices after all wall preparation, including painting, is complete.

C. Device Installation:

1. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up and on horizontally mounted receptacles to the left.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

E. 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.

F. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 FIELD QUALITY CONTROL

A. 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.

B. 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 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

a. Control circuits.
b. Motor-control centers.
c. Panelboards.
d. Switchboards.
e. Enclosed controllers.
f. Enclosed switches.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

### 1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. Bussman

### 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, time delay.
4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, time delay.
5. Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
7. Type T: 600-V, zero- to 800-A rating, 200 kAIC, time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) Main Electrical Room.

### 3.2 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

# SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

### 1.2 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. 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.

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.

### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

C. Field quality-control reports.

### 1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.6 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) 1 year(s) from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 FUSIBLE SWITCHES

A. Eaton, Square D, Siemens

B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 240, 600 -V ac.
4. 1200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

A. Type HD, Heavy Duty, Three Pole, Single Throw, 240 600-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. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Service-Rated Switches: Labeled for use as service equipment.

## 2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Eaton, Square D, Siemens

B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

D. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated Circuit breaker/circuit breaker

E. MCCBs shall be equipped with a device for locking in the isolated position.

F. Lugs shall be suitable for 167 deg F (75 deg C) rated wire.

G. Standards: Comply with UL 489 with interrupting capacity to comply with available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Long- and short-time pickup levels.
2. Long- and short-time time adjustments.
3. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
5. Alarm Switch: One NO, NC contact that operates only when circuit breaker has tripped.

2.4 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 gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

**PART 3 - EXECUTION**

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen / Wash-Down Areas: NEMA 250, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7 with cover attached by Type 316 stainless steel bolts.

## 3.2 INSTALLATION

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect, Construction Manager, Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Architect's, Construction Manager's, Owner's written permission.
4. Comply with NFPA 70E.

B. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

C. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Install fuses in fusible devices.

G. Comply with NFPA 70 and NECA 1.

H. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies." to values indicated on the Drawings.

## 3.3 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.

## 3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

D. Tests and Inspections for Switches:

1. Visual and Mechanical Inspection:

a. Inspect physical and mechanical condition.
b. Inspect anchorage, alignment, grounding, and clearances.
c. Verify that the unit is clean.
d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
e. Verify that fuse sizes and types match the Specifications and Drawings.
f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
i. Verify correct phase barrier installation.
j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

E. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.

f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. 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.

END OF SECTION 262816

**SECTION 264313 – SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

## PART 1 **GENERAL**

### 1.1 WORK INCLUDED

A. Section IncludesSurge Protective Devices (SPDs) for the protection of AC electrical circuits and electronic equipment from the effects of lightning induced transients, other externally generated transients, and internally generated transients.

B. All materials shall be listed by an OSHA approved Nationally Recognized Testing Laboratory (NRTL).

### 1.2 REFERENCE STANDARDS:

A. ANSI/IEEE:

1. C62.33 IEEE - Standard Test Specifications for Varistor Surge-Protective Devices.
2. C62.41 IEEE - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
3. C62.45-87 IEEE - Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
4. 142 IEEE - Recommended Practice for Grounding of Industrial and Commercial Power Systems (IEEE Green Book).

B. Underwriters Laboratories (UL):

1. UL 1449 Standard for Safety, Transient Voltage Surge Suppressors (3rd Edition).
2. UL 1283 Electromagnetic Interference Filters.

C. National Fire Protection Association (NFPA):

1. NFPA 70 National Electrical Code (NEC).
2. NFPA 75 Standard for the Fire Protection of Information Technology Equipment.
3. NFPA 780 Lightning Protection Standards.

### 1.3 QUALITY ASSURANCE

A. The manufacturer shall submit a written statement indicating that a factory authorized representative inspected the installation. The installing contractor shall submit a checkout memorandum to the manufacturer indicating the date the equipment was placed into service and the actual method of installation. Submit three copies of each to the A/E.

B. All SPDs for service entrance, distribution, and branch circuit protection within a facility shall be provided by a single manufacturer.

## 1.4 WARRANTY

A. The SPD and supporting components shall be guaranteed by the manufacturer to be free of defects in material and workmanship for a period of 5 years from the date of substantial completion of service and activation of the system to which the SPD is attached.

B. An SPD that shows evidence of failure or incorrect operation during the warranty period shall be repaired or replaced, including labor and materials, at no expense to M-DCPS. Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPD shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this warranty. The warranty shall cover the entire device, not just the modules.

C. The installation of SPDs in or on electrical distribution equipment shall in no way compromise or violate equipment listing, labeling, or warranty of the distribution equipment.

## 1.5 SUBMITTALS

A. Submittals shall include, but not be limited to, the following information:

1. Data for each SPD type indicating conductor sizes, conductor types, connection configuration and lead lengths.
2. Manufacturer’s certified test data indicating the ability of each SPD to meet or exceed requirements of this specification.
3. Drawings, with dimensions, indicating SPD mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies.
4. List and detail protection systems such as fuses, disconnecting means and protective materials.
5. SPD wiring, bonding and grounding connections shall be indicated on the wiring diagrams for each system. Include installation details demonstrating mechanical and electrical connections to equipment to be protected.
6. If requested, a sample of each SPD type shall be submitted for use in testing and evaluation.

# PART 2 **PRODUCTS**

## 2.1 MANUFACTURERS

A. Transient Voltage Surge Suppression:

1. Eaton Corp.
2. Advanced Protection Technologies.
3. PowerLogics

## 2.2 PERFORMANCE

A. General:

1. SPDs shall be listed according to UL – Third Edition 1449 Standard for Safety, Transient Voltage Surge Suppressors, and UL 1283, Electromagnetic Interference Filters.

2. Services entrance equipment SPD's shall be labeled as Type 1 with 10 modes of protection: 3-modes (Line-to-line) 3-modes (Line-to-Ground), 3-modes (Line-to-Neutral), and 1-mode (Neutral-to-Ground) for a 3-phase, 4-Wire plus ground voltage system. (Line-to-Neutral-to-Ground is not an acceptable substitute for Line-to-Ground).
3. Distribution and panelboard SPD's shall be labeled Type 1 with 7 modes of protection: 3 modes (line-to-ground), 3 modes (line-to-neutral), and 1 mode (neutral-to-ground) for a 3-phase, 4 wire plus ground voltage system. (Line-to-Neutral-to-Ground is not an acceptable substitute for Line-to-Ground).
4. Provide an SPD at the panelboard powering the security camera head-end equipment.
5. The UL 1449 Clamping Voltage for the following configurations shall not exceed the following:

| VOLTAGE CONFIGURATION | L-G | L-N | N-G | L-L |
|---|---|---|---|---|
| 120/208V | 700V | 700V | 700V | 1200V |
| 277/480V | 1200V | 1200V | 1200V | 1800V |

6. The unit shall be UL 1283 listed as an electromagnetic interference filter. Standardized insertion loss data shall be obtained using MIL-STD E220A 50W insertion loss methodology. Minimum insertion loss shall be as follows:

| FREQUENCY[MHz] | INSERTION LOSS[dB] |
|---|---|
| 0.1 | 34 |
| 1.0 | 51 |
| 10.0 | 54 |
| 100.0 | 48 |

7. SPDs shall use a separate path to building ground, the equipment safety ground is not to be used as a transient ground path.
8. SPDs shall be constructed using metal oxide varistors (MOV) based modules. Each SPD shall have a response time of less than one nanosecond with 6 inches or less of connected lead length for any individual protection mode.
9. Each MOV contained within a current diversion module shall be individually fused (component level safety fusing). For the assurance of safety purposes, this feature shall be a standard design feature and not an optional feature of the product. The individual component level fusing shall allow a reduction of protection rather than an automatic complete loss of protection.
10. The maximum continuous operating voltage (MCOV) of all components shall not be less than 125 percent for a 120/208 volt system with MCOV of 150 volts and 115 percent for 277/480 volt, systems with MCOR of 320 volts.
11. The minimum surge current capacity (single pulse rated) per phase shall be:

    a. Service Entrance: 300 KA
    b. Distribution Panelboard: 200 KA
    c. Lighting and Power Panelboard: 100KA

12. SPD's shall include visual LED diagnostics indicators, and audible alarm with silence.

## PART 3 **EXECUTION**

### 3.1 INSTALLATION

A. The contractor shall install the parallel SPD with short and straight conductors, not to exceed 18 inches long.

B. Service entrance SPD's shall have a 60 amp, 3-pole circuit breaker protection and distribution and lighting/power panelboards shall have a 30 amp, 3-pole circuit breaker protection. Connect SPDs with #6AWG wire gauge minimum.

C. The contractor shall follow the SPD manufacturer's recommended installation practice as found in the equipment installation manual.

D. The installation shall apply to all applicable codes.

END OF SECTION 264313

# SECTION 265119 – LED INTERIOR LIGHTING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Highbay, linear.
4. Highbay, nonlinear.
5. Linear industrial.
6. Lowbay.
7. Parking garage.
8. Recessed, linear.
9. Strip light.
10. Surface mount, linear.
11. Surface mount, nonlinear.
12. Suspended, linear.
13. Suspended, nonlinear.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
2. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire 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.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 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. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.5 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

C. Ambient Temperature:

1. Relative Humidity: Zero to 95 percent.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

## 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. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

## 2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

## 2.5 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 (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## PART 3 - EXECUTION

### 3.1 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. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

### 3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.3 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 emergency power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

# SECTION 265213 – EMERGENCY AND EXIT LIGHTING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Emergency lighting units.
2. Exit signs.
3. Luminaire supports.

### 1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and 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.

### 1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:

B. Product Certificates: For each type of luminaire.

C. Seismic Qualification Data: Certificates, for luminaires, accessories, and components, from manufacturer.

D. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 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. Warranty Period: Two year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

**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 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for recessed luminaires.

F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.

1. Emergency Connection: Operate one lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.

2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
    b. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
    c. Humidity: More than 95 percent (condensing).
    d. Altitude: Exceeding 3300 feet (1000 m).

4. Test Push-Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

5. Battery: Sealed, maintenance-free, nickel-cadmium type.
6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

## 2.3 EMERGENCY LIGHTING

A. General Requirements for Emergency Lighting Units: Self-contained units.

B. Emergency Luminaires:
1. Emergency Luminaires: as indicated on Drawings, with the following additional features:

    a. Operating at nominal voltage of 277 V ac.
    b. Internal emergency power unit.
    c. Rated for installation in damp locations, and for sealed and gasketed fixtures in wet locations.
    d. UL 94 5VA flame rating.

C. Emergency Lighting Unit:
1. Emergency Lighting Unit: as indicated on Drawings.
2. Operating at nominal voltage of 277 V ac.
3. Wall with universal junction box adaptor.
4. UV stable thermoplastic housing, rated for damp locations.
5. Two LED lamp heads.
6. Internal emergency power unit.
7. External emergency power unit.

2.4 EXIT SIGNS

A. Internally Lighted Signs:
1. Operating at nominal voltage of 277 V ac.
2. Lamps for AC Operation: Fluorescent, two for each fixture; 20,000 hours of rated lamp life.
3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
4. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

B. Self-Luminous Signs:
1. Powered by tritium gas, with universal bracket for flush-ceiling, wall, or end mounting. Signs shall be guaranteed by manufacturer to maintain the minimum brightness requirements in UL 924 for 10 years.
2. Use strontium oxide aluminate compound to store ambient light and release the stored energy when the light is removed. Include universal bracket for flush-ceiling, wall, or end mounting.

2.5 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. Doors, Frames, and Other Internal Access:

1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.
3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Prismatic glass, Prismatic acrylic.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
4. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:

1. Extruded aluminum housing and heat sink.
2. Clear anodized, powder coat, painted finish.

E. Conduit: Electrical metallic tubing, minimum 3/4 inch (21 mm) in diameter.

2.6 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

**PART 3 - EXECUTION**

3.1 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 and emergency power unit weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.

E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach fixtures directly to gypsum board.

F. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.

H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. 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.

C. Prepare test and inspection reports.

END OF SECTION 265213

# SECTION 265613 – LIGHTING POLES AND STANDARDS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Poles and accessories for support of luminaires.

### 1.2 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete luminaire.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

### 1.3 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device.

B. Shop Drawings:

1. Include plans, elevations, sections, and 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. Detail fabrication and assembly of poles and pole accessories.
4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
6. Method and procedure of pole installation. Include manufacturer's written installations.

### 1.4 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Material test reports.

C. Field quality-control reports.

D. Sample warranty.

E. Soil test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data for pole-lowering devices and pole-mounted accessories.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Structural Characteristics: Comply with AASHTO LTS-6-M.

C. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

D. Live Load: Single load of 500 lbf (2200 N) distributed according to AASHTO LTS-6-M.

E. Ice Load: Load of 3 lbf/sq. ft. (145 Pa), applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

F. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.

1. Basic wind speed for calculating wind load for poles 50 feet (15 m) high or less is [170 mph (60 m/s).

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 25 years.
c. Velocity Conversion Factor: 1.0.

G. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

H. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

A. Source Limitations: Obtain poles from single manufacturer or producer.

B. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

C. Poles: Comply with ASTM A500/A500M, Grade B carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in height with access handhole in pole wall.

1. Shape: Round, tapered.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Fasteners: [Stainless steel] [Galvanized steel] <Insert finish or grade>, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

F. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

G. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

H. Intermediate Handhole and Cable Support: Weatherproof, 3-by-5-inch (76-by-130-mm) handhole located at midpoint of pole, with cover for access to internal welded attachment lug for electric cable support grip.

I. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported load multiplied by a 5.0 safety factor.

J. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

K. Galvanized Finish: After fabrication, hot-dip galvanize according to ASTM A123/A123M.

L. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a

smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.

2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high gloss, high-build polyurethane enamel.

    a. Color: As selected by Architect from manufacturer's full range.

M. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder Coat: Comply with AAMA 2604.

    a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils (64- to 89-um) dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
    b. Color:As selected by Architect from manufacturer's full range.

## 2.3 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B221, Alloy 6063-T6, with access handhole in pole wall.

1. Shape: Round, tapered.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

C. Grounding and Bonding Lugs: Bolted 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

D. Fasteners: Galvanized steel , size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.

1. Materials: Compatible with poles and standards as well as to substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

E. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches (65 by 130 mm), with cover secured by stainless-steel captive screws.

F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I clear coating of 0.018 mm or thicker), complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

H. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color:As selected by Architect from manufacturer's full range.

I. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Powder coat shall comply with AAMA 2604.

    a. Electrostatic applied powder coating; single application with a minimum 2.5- to 3.5-mils (64- to 89-um) dry film thickness; cured according to manufacturer's instructions. Coat interior and exterior of pole for equal corrosion protection.
    b. Color: As selected by Architect from manufacturer's full range.

## 2.4 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

B. Transformer-Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and to accept ballast(s) indicated accessories. Include removable flanged access cover secured with bolts or screws.

2.5 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to [ASTM F1554, Grade 55,] with a minimum yield strength of 55,000 psi (380 000 kPa).

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
2. Headed rods.
3. Threading: Uniform National Coarse, Class 2A.

B. Nuts: ASTM A563, Grade A, Heavy-Hex.

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
2. Four nuts provided per anchor bolt , shipped with nuts pre-assembled to the anchor bolts.

C. Washers: ASTM F436, Type 1.

1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
2. Two washer(s) provided per anchor bolt.

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 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 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Pre-Cast Foundations: Factory fabricated, with structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

C. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.

1. Make holes 6 inches (150 mm) in diameter larger than pole diameter.

2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi (20 MPa) at 28 days and finish in a dome above finished grade.
3. Use a short piece of 1/2-inch (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
4. Cure concrete a minimum of 72 hours before performing work on pole.

D. Anchor Bolts: Install plumb using manufacturer-supplied steel template, uniformly spaced.

## 3.2 POLE INSTALLATION

A. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.

C. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch- (150-mm-) wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch (25 mm) below top of concrete slab.

D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

## 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 using insulating fittings or treatment.

B. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

## 3.4 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole.
2. Install grounding conductor and conductor protector.
3. Ground metallic components of pole accessories and foundation.

END OF SECTION 265613

# SECTION 265619 – LED EXTERIOR LIGHTING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

### 1.2 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.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 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. Warranty Period: 2 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61.

F. CRI of minimum 80 CCT of 4100 K.

G. L70 lamp life of 50,000 hours.

H. Nominal Operating Voltage: 277 V.

I. Retain "In-line Fusing" Paragraph below when an integral fuse is desired. Coordinate with the Exterior Luminaire Schedule on Drawings.

J. In-line Fusing: Separate in-line fuse for each luminaire.

K. Lamp Rating: Lamp marked for outdoor use.

2.2 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum, 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. 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.

2.3 FINISHES

A. Variations in Finishes: 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.

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.

2.4 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 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Install lamps in each luminaire.

C. Fasten luminaire to structural support.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.3 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

END OF SECTION 265619

## SECTION 265668 – EXTERIOR ATHLETIC LIGHTING PERFORMANCE SPECS

Lighting System with LED Light Source

### PART 1 – GENERAL

1.1 SUMMARY

A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans as well as state and local codes.

B. The purpose of these specifications is to define the lighting system performance and design standards for West End Park using an LED Lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.

C. The sports lighting will be for the following venues:

1. Soccer Field 262’ by 164’
2. Softball Field – 150’ Radius
3. (2) Tennis Courts
4. (2) Basketball Courts
5. Pool – per plans
6. Pool & Deck – per plans
7. Splash Pad – per plans
8. Security Lighting – (1) Fixture on A1, S4, & S2

D. The primary goals of this sports lighting project are:

1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore light levels are guaranteed to not drop below specified target values for a period of 25 years.
2. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators and neighbors.
3. Cost of Ownership: In order to reduce the operating budget, the preferred lighting system shall be energy efficient and cost effective to operate. All maintenance costs shall be eliminated for the duration of the warranty.
4. Control and Monitoring: To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields should be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.

1.2 LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not to drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period.

| Area of Lighting | Average Target Illumination Levels | Maximum to Minimum Uniformity Ratio | Grid Points | Grid Spacing |
|---|---|---|---|---|
| Soccer | 30 FC | 2.5:1.0 | 54 | 30’ x 30’ |
| Softball Infield | 50 FC | 2.0:1.0 | 25 | 20’ x 20’ |
| Softball Outfield | 30 FC | 2.5:1.0 | 31 | 20’ x 20’ |
| Tennis | 30 FC | 2.5:1.0 | 30 | 20’ x 20’ |
| Basketball | 30 FC | 3.0:1.0 | 120 | 10’ x 10’ |
| Pool | 30 FC | 2.0:1.0 | 63 | 10’ x 10’ |
| Pool & Deck | 30 FC | N/A | 151 | 10’ x 10’ |
| Splash Pad | 40 FC | 1.5:1.0 | 15 | 10’ x 10’ |

B. Color: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.

C. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.

| # of Poles | Pole Designation | Pole Height |
|---|---|---|
| 2 | A1 – A2 | 60’ |
| 2 | B1 – B2 | 60’ |
| 2 | BA1 – BA2 | 60’ |
| 5 | P1 – P5 | 40’ |
| 4 | S1 – S4 | 60’ |
| 4 | T1 – T4 | 60’ |

1.3 ENVIRONMENTAL LIGHT CONTROL

A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields. No symmetrical beam patterns are accepted.

Lighting designs shall also meet the beam distributions standards set forth by the IES RP-6-15 in Section 5.4.1. Beam Types Figure 14: NEMA Sports Lighting Luminaire Classification.

B. A technical document addressing the issue of lighting in the vertical plane above the playing surface for aerial sports while achieving desired glare control requirements will be required for approval.

C. Spill Light and Glare Control: To minimize impact on adjacent properties, spill light and candela values must not exceed the following levels taken at 3 feet above grade.

| Phase 2 & 3 | Vertical Maximum | Candela Maximum |
|---|---|---|
| North Property Line | 4.0 | 54,000 |
| East Property Line | 3.2 | 8,000 |
| South Property Line | 0.5 | 2,000 |
| West Property Line | 5.0 | 40,000 |

If a manufacturer's photometric report indicates that they cannot meet this criteria, they may increase mounting heights (see below) to maintain the same impact for playability, spectator comfort and impact on the adjoining properties.

This mounting height increase will be calculated by referencing the fixture photometric report and determining the angle above vertical that the fixture achieves a candela reading less than or equal to 10,000 candela. Pole heights will be increased 3.33' for every one degree above 13.0 degrees needed to achieve a candela reading of 10,000.

D. Spill Scans: Spill scans must be submitted indicating the amount of horizontal and vertical footcandles along the specified lines. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights. Illumination level shall be measured in accordance with the IESNA LM-5-04 after 1 hour warm up.

E. The efficacy for field aimed fixtures must meet DLC requirement of 105 lumens per watt.

F. The first page of a photometric report for all luminaire types proposed showing horizontal and vertical axial candle power shall be provided to demonstrate the capability of achieving the specified performance. Reports shall be certified by a qualified testing laboratory with a minimum of five years experience or by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products. A summary of the horizontal and vertical aiming angles for each luminaire shall be included with the photometric report.

G. Upper Beam Definition

Fixtures shall not exceed the candlepower at the specified degrees above the center of the beam in the vertical plane as specified in the following table.

| NEMA Classification of Vertical Beam | Candela | Degrees Above the Center of the Beam in the Vertical Plane |
|---|---|---|
| 4 | 10,000 | 13.0 degrees |

1.4 LIGHTING FOR AERIAL SPORTS

For fixtures that provide less than 10,000 candela above 22 degrees vertical, the owner requires luminaires mounted approximately 15' above grade to provide targeted light above the playing field. These fixtures will not emit direct light less than 10° above the horizon and no more than 10% of the total (directly) applied lumens as modeled may be in this area.

**PART 2 – PRODUCT**

2.1 SPORTS LIGHTING SYSTEM CONSTRUCTION

A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.

B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or

anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

C. System Description: Lighting system shall consist of the following:

1. Galvanized steel poles and cross-arm assembly.

2. Non-approved pole technology:

    a. Square static cast concrete poles will not be accepted.

    b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.

3. Lighting systems shall use concrete foundations. See Section 2.4 for details.

    a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill must bear on and against firm undisturbed soil.

    b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or re-enforced pier design pole erection may occur after 7 days. Or after a concrete sample from the same batch achieves a certain strength.

4. Manufacturer will supply all drivers and supporting electrical equipment

    a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure will be located in the enclosure. Integral drivers are not allowed.

    b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.

        If active cooling fans are utilized in the remote driver enclosure, then these are required to be wired for the control system to self-monitor and automatically report any failure or issue to the manufacturer and/or owner. Technical cutsheets (not illustrative) detailing this function would be a required inclusion in the mandatory pre-bid submittal detailed in Section 4.

        Integral drivers are not acceptable.

5. Wire harness complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.

6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mi/h winds and maintain luminaire aiming alignment.

7. Control cabinet to provide remote on-off control, monitoring, of the lighting system. See Section 2.3 for further details.

8. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.

   a. Integrated grounding via concrete encased electrode grounding system.

   b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780.The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

D. Safety: All system components shall be UL listed for the appropriate application.

## 2.2 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:
   1. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the field lighting system shall be 46 KW or less

## 2.3 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) with electrically-held contactors, constructed of NEMA Type 4 aluminum and designed for easy installation with contactors labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided. Under no circumstances shall the owner need to switch lights on / off by the use of breakers.

C. Dimming: System shall provide for 3-stage dimming (high-medium-low). Dimming will be set via scheduling options (Website, app, phone, fax, email)

D. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

The owner may assign various security levels to schedulers by function and/or fields. This function must be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute “early off” commands by phone. Scheduling tool shall be capable of setting curfew limits.

Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

E. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

F. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application will be provided suitable for IOS, Android and Blackberry devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for the field lighting system that is readily accessible to the owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility
2. Report hours saved by using early off and push buttons by users.

G. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.

H. Communication with luminaire drivers: Control system shall interface with drivers in pole-mounted enclosures by means of powerline communication through the underground conductors.

Control systems utilizing a wireless line-of-sight communication pathway to the luminaire drivers where power is fed directly from circuit breaker to light pole, and in which power distribution to the pole is constant regardless of on/off luminaire status -- are not acceptable due to long-term performance reliability risks.

2.4 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the 2020 Florida Building Code. Wind loads to be calculated using ASCE 7-10, an ultimate design wind speed of 175, High Velocity Hurricane Zone, and exposure category C. Designing poles per AASHTO standards is NOT allowed under the Florida Building Code.

B. Engineered Foundation Drawings: Project-specific foundation drawings --- stamped by a registered professional engineer in the state of Florida --- are required. The foundation drawings must list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. Building code & wind speed must be listed on the structural foundation drawings. The cost for this design shall be incorporated into the Bidder's proposal.

**PART 3 – EXECUTION**

3.1 SOIL QUALITY CONTROL

A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for

additional costs associated with:

1. Providing engineered foundation embedment design by a registered engineer in the State of FL for soils other than specified soil conditions;

2. Additional materials required to achieve alternate foundation;

3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.2 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment must be on-site 8-10 weeks from receipt of approved submittals and receipt of complete order information.

3.3 FIELD QUALITY CONTROL

A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.

B. Field Light Level Accountability

1. Light levels are guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels will be specifically stated as “guaranteed” on the illumination summary provided by the manufacturer.

2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.

3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

C. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed Representative, the actual performance levels including footcandles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.4 WARRANTY AND GUARANTEE

A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment.

Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

PART 4 – DESIGN APPROVAL

4.0 PRE-BID SUBMITTAL REQUIREMENTS

A. Design Approval: The owner / engineer will review pre-bid submittals per section 4.0.B from all the manufacturers to ensure compliance to the specification 10 days prior to bid. If the design meets the design requirements of the specifications, a letter and/or addendum will be issued to the manufacturer indicating approval for the specific design submitted.

B. Basis of Design Product: Musco's Light-Structure System™ with TLC for LED™ is the approved product or equal. All substitutions must provide a complete submittal package for approval as outlined in Submittal Information at the end of this section at least 10 days prior to bid. Special manufacturing to meet the standards of this specification may be required. An addendum will be issued prior to bid listing any other approved lighting manufacturers and designs.

C. All listed manufacturers not pre-approved shall submit the information at the end of this section at least 10 days prior to bid. An addendum will be issued prior to bid; listing approved lighting manufacturers and the design method to be used.

D. Bidders are required to bid only products that have been approved by this specification or addendum by the owner or owner's representative. Bids received that do not utilize an approved system/design, will be rejected.

REQUIRED SUBMITTAL INFORMATION FOR ALL MANUFACTURERS (NOT PRE-APPROVED) 10 DAYS PRIOR TO BID

All items listed below are mandatory, shall comply with the specification and be submitted according to pre-bid submittal requirements. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. Submit checklist below with submittal.

| Yes/ No | Tab | Item | Description |
|---|---|---|---|
| | A | Letter/ Checklist | Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included. |
| | B | Equipment Layout | Drawing(s) showing field layouts with pole locations |
| | C | On Field Lighting Design | Lighting design drawing(s) showing:<br>a. Field Name, date, file number, prepared by<br>b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified<br>c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics<br>d. Height of light test meter above field surface.<br>e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor. |

| | | | |
|---|---|---|---|
| | | | f. Technical document addressing the issue of lighting in the vertical plane above the playing surface for aerial sports while achieving the desired glare control requirements. |
| | D | Off Field Lighting Design | Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights. |
| | E | Photometric Report | Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience. No partial wattage fixture reports or ISO Polar curve reports are acceptable. |
| | F | Performance Guarantee | Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period. |
| | G | Structural Calculations | Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of FL, if required by owner. (May be supplied upon award). |
| | H | Control & Monitoring System | Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system. They will also provide ten (10) references of customers currently using proposed system in the state of FL. |
| | I | Electrical Distribution Plans | Manufacturer bidding an alternate product must include a revised electrical distribution plan including changes to service entrance, panels and wire sizing, signed by a licensed Electrical Engineer in the state of FL. |
| | J | Warranty | Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of FL. |
| | K | Project References | Manufacturer to provide a list of 10 projects where the technology and specific fixture proposed for this project has been installed in the state of FL. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number. |
| | L | Product Information | Complete bill of material and current brochures/cut sheets for all product being provided. Cut sheets shall be technical (and illustrative) and provide specific detail on fixtures, remote driver cabinets, drivers, surge protections, fusing, controls, poles and foundations. All certifications including UL and DLC shall be shown on the technical cut sheets. |
| | M | Delivery | Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information. |
| | N | Non-Compliance | Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted. |
| | O | Cost of Ownership | Document cost of ownership as defined in the specification. Identify energy costs for operating the luminaires. Maintenance cost for the system must be included. All costs should be based on 25 Years |
| | P | Environmental Light Control Design | Environmental glare impact scans must be submitted showing the maximum candela from the field edge on a map of the surrounding area. |

END OF SECTION 265668

# SECTION 270529 – HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Steel slotted support systems for communication raceways.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Structural steel for fabricated supports and restraints.
5. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
6. Fabricated metal equipment support assemblies.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Trapeze hangers. Include product data for components.
2. Steel slotted-channel systems.
3. Aluminum slotted-channel systems.

### 1.3 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles, with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Galvanized steel.
3. Channel Width: 1-5/8 inches (41 mm).
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.
7. 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. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

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 (Grade A325M).
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

1.4 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

**PART 2 - EXECUTION**

2.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports.

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-C.
4. NECA 101.
5. NECA 102.
6. NECA 105.
7. NECA 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for pathways specified in Section 270528 "Pathways for Communications Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other ]support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

2.2 SUPPORT INSTALLATION

A. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC and RMC may be supported by openings through structure members, according to NFPA 70.

B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten communications items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Use approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Use expansion anchor fasteners.
5. Instead of expansion anchors, powder-actuated-driven threaded studs, provided with lock washers and nuts, may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

2.3 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.

D. 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 SUMMARY

A. Section Includes:

1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

2. Sealing Elements: EPDM Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. 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.

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

a. Presealed Systems.

## 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.
2. Sealant 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."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

**PART 3 - EXECUTION**

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch 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 270553 – IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Color and legend requirements for labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes.
5. Signs.
6. Cable ties.
7. Fasteners for labels and signs.

### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Identification Schedule:

1. Outlets: Scaled drawings indicating location and proposed designation.
2. Backbone Cabling: Riser diagram showing each communications room, backbone cable, and proposed backbone cable designation.
3. Racks: Scaled drawings indicating location and proposed designation.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70 and TIA 606-B.

B. Comply with ANSI Z535.4 for safety signs and labels.

C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Equipment Identification Labels:

1. Black letters on a white field.

2.3 SIGNS

A. Laminated-Acrylic or Melamine-Plastic Signs:

1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.
b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.
c. Engraved legend with black letters on white face.

2.4 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 (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

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 (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C) according to ASTM D638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. 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 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. Verify identity of each item before installing identification products.

C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

D. Apply identification devices to surfaces that require finish after completing finish work.

E. Install signs with approved legend to facilitate proper identification, operation, and maintenance of communications systems and connected items.

F. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

G. 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.
3. Provide label 6 inches (150 mm) from cable end.

H. Snap-Around Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches (150 mm) from cable end.

I. Self-Adhesive Wraparound Labels:

1. Secure tight to surface at a location with high visibility and accessibility.
2. Provide label 6 inches (150 mm) from cable end.

J. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

K. Cable Ties: General purpose, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.2 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 with high visibility. Identify by system and circuit designation.

C. Accessible Fittings for Raceways and Cables within Buildings: Identify covers of each junction and pull box with self-adhesive labels containing wiring system legend.

1. System legends shall be as follows:

a. Telecommunications.

D. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, numbered clockwise when entering room from primary egress, composed of the following, in the order listed:

1. Wiring closet designation.
2. Colon.
3. Faceplate number.

E. Equipment Room Labeling:

1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels containing equipment designation.
2. Patch Panels: Label individual rows in each rack, starting at top and working down, with self-adhesive labels.
3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed:

a. Room number being served.
b. Colon.
c. Faceplate number.

F. Backbone Cables: Label each cable with a vinyl-wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.

G. Horizontal Cables: Label each cable with a vinyl-wraparound label indicating the following, in the order listed:

1. Room number.
2. Colon.
3. Faceplate number.

H. Instructional Signs: Self-adhesive labels.

I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.

J. Equipment Identification Labels:

1. Indoor Equipment: Self-adhesive label.
2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.
3. Equipment to Be Labeled:

    a. Communications cabinets.
    b. Uninterruptible power supplies.

END OF SECTION 270553

# SECTION 284621.11 – ADDRESSABLE FIRE-ALARM SYSTEMS

## PART 1 - GENERAL

### 1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Nonsystem smoke detectors.
5. Heat detectors.
6. Notification appliances.
7. Magnetic door holders.
8. Remote annunciator.
9. Addressable interface device.
10. Digital alarm communicator transmitter.

B. Related Requirements:

1. Section 271513 "Communications Copper Horizontal Cabling" for cables and conductors for fire-alarm systems.

### 1.2 ACTION SUBMITTALS

A. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician.
    c. Licensed or certified by authorities having jurisdiction.

B. Product Data: For each type of product, including furnished options and accessories.

C. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and 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 statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.

    a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    b. Show field wiring required for HVAC unit shutdown on alarm.
    c. Locate detectors according to manufacturer's written recommendations.

12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

D. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
3. Indicate audible appliances required to produce square wave signal per NFPA 72.

## 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for fire-alarm control unit, accessories, and components, from manufacturer.

C. Field quality-control reports.

D. Sample warranty.

## 1.4 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 the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment.
d. Riser diagram.
e. Record copy of site-specific software.
f. Provide "Inspection and Testing Form" according to the "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.

g. Manufacturer's required maintenance related to system warranty requirements.
h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm technician.

C. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL (nationally recognized testing laboratory).

D. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

E. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FM Global-approved alarm company.

F. NFPA Certification: Obtain certification according to NFPA 72.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Carbon monoxide detectors.
6. Automatic sprinkler system water flow.
7. Fire-extinguishing system operation.
8. Fire standpipe system.
9. Dry system pressure flow switch.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Activate preaction system.
9. Activate emergency lighting control.
10. Activate emergency shutoffs for gas and fuel supplies.
11. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, or remote annunciator.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

## 2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways 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.

## 2.4 FIRE-ALARM CONTROL UNIT

A. Manufacturer: Notifier

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision.

Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

## 2.5 MANUAL FIRE-ALARM BOXES

A. Manufacturer: Notifier

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.

1. Single-action mechanism, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

## 2.6 SYSTEM SMOKE DETECTORS

A. Manufacturer: Notifier or approved equal.

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

D. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

E. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.7 HEAT DETECTORS

A. Manufacturer: Notifier

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.

1. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature.

1. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.8 NOTIFICATION APPLIANCES

A. Manufacturer: Notifier or approved equal.

B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Chimes: Vibrating type.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464.

E. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Mounting: Wall mounted unless otherwise indicated.
2. Flashing shall be in a temporal pattern, synchronized with other units.
3. Strobe Leads: Factory connected to screw terminals.
4. Mounting Faceplate: Factory finished

## 2.9 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

## 2.10 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.
2. Operate solenoids for use in sprinkler service.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply.
5. Loss of power.
6. Low battery.

7. Abnormal test signal.
8. Communication bus failure.

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 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

C. Equipment Mounting: Install fire-alarm control unit on finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

D. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."

E. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

F. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.

G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.

H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

I. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

J. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

## 3.2 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

## 3.3 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated HVAC duct systems.
2. Magnetically held-open doors.
3. Electronically locked doors and access gates.
4. Alarm-initiating connection to activate emergency lighting control.
5. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
6. Supervisory connections at valve supervisory switches.
7. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
8. Supervisory connections at fire-extinguisher locations.

## 3.4 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 a location visible from fire-alarm control unit.

3.5 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.6 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by Architect , authorities having jurisdiction

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.7 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 284621.11

# SECTION 310522 - GEOTEXTILES USED AS FILTERS

## PART 1 GENERAL

### 1.1 UNIT PRICES

#### 1.1.1 Payment

Payment will be made at the contract unit price and will constitute full compensation to the Contractor for providing all plant, labor, material, and equipment and performing all operations necessary for the complete and satisfactory installation of the geotextile. The following items are included in the contract unit price for Geotextiles and will not be counted a second time in the process of determining the extent of geotextile placed: Material and associated equipment and operation used in laps, seams, or extra length; securing pins and associated material, equipment, and operations; and material and associated equipment and operations used to provide cushioning layer of sand or gravel or both to permit increase in allowable drop height of stone. No payment will be made for geotextiles replaced because of waste, contamination, damage, repair, or due to CONTRACTOR fault or negligence.

#### 1.1.2 Measurement

Installed geotextiles will be measured for payment in place to the nearest square yard of protected area as delineated in the drawings.

#### 1.1.3 Unit of Measure

Unit of measure: Square yard.

### 1.2 REFERENCES

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.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D123 | Terminology Relating to Textile |
| ASTM D4354 | Sampling of Geosynthetics for Testing |
| ASTM D4355 | Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus |
| ASTM D4491 | Water Permeability of Geotextiles by Permittivity |
| ASTM D4533 | Trapezoid Tearing Strength of Geotextiles |
| ASTM D4632 | Grab Breaking Load and Elongation of Geotextiles |
| ASTM D4751 | Determining Apparent Opening Size of a Geotextile |

| | |
|---|---|
| ASTM D4573 | Identification, Storage, and Handling of Geosynthetic Rolls and Samples |
| ASTM D4884 | Strength of Sewn or Thermally Bonded Seams of Geotextiles |
| ASTM D6241 | Static Puncture Strength of Geotextiles and Geotextile Related Products Using a 50-mm Probe |

1.3 SUBMITTALS

Submit the following in accordance with the General Conditions of the contract:

Samples and Catalog Cut

Geotextile

Certificates

Geotextile

Placement Methodology

Narrative text, with appropriate sketches, for placement of geotextile. Include details for overlap and wrapping of armor stone.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver only approved geotextile to the project site. All geotextile shall be labeled, shipped, stored, and handled in accordance with ASTM D4873. No hooks, tongs, or other sharp instruments shall be used for handling geotextile.

**PART 2 PRODUCTS**

2.1 MATERIALS

2.1.1 Geotextile

Upon delivery of the geotextile, submit duplicate copies of the written certificate of compliance signed by a legally authorized official of the manufacturer. The certificate shall state that the geotextile shipped to the site meets the chemical requirements and exceeds the minimum average roll value listed in TABLE 1 below.

2.1.1.1 General

The approved geotextile shall be the Mirafi FW700 as manufactured by Tencate. An alternative woven geotextile matching or exceeding the minimum average roll values listed in TABLE 1 may be considered by the OWNER. Strength values indicated in the table are for the weaker principal direction.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

| PROPERTY | UNITS | ACCEPTABLE VALUES | TEST METHOD |
|---|---|---|---|
| GRAB STRENGTH | lb | 250 | ASTM D4632 |
| SEAM STRENGTH | lb/in | 225 | ASTM D4884 |
| CBR PUNCTURE | lb | 950 | ASTM D6241 |
| TRAPEZOID TEAR | lb | 60 | ASTM D4533 |
| PERMEABILITY | cm/sec | 0.01 | ASTM D4491 |
| APPARENT OPENING SIZE | U.S. SIEVE (mm) | 70 (0.212) | ASTM D4751 |
| PERMITTIVITY | sec -1 | 0.28 | ASTM D4491 |
| ULTRAVIOLET DEGRADATION | Percent Strength Retained | 90 at 500 HRS | ASTM D4355 |

2.1.1.2 Geotextile Fiber

Fibers used in the manufacturing of the geotextile shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of polyolefins, polyesters, or polyamides. Add stabilizers and/or inhibitors to the base polymer, if necessary to make the filaments resistant to deterioration caused by ultraviolet light and heat exposure. Reclaimed or recycled fibers or polymer shall not be added to the formulation. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Finish the edges of the geotextile to prevent the outer fiber from pulling away from the geotextile.

2.1.2 Seams

Sew the seams of the geotextile with thread of a material meeting the chemical requirements given above for geotextile yarn or bond the seams by cementing or by heat. Attach the sheets of geotextile at the factory or another approved location, if necessary, to form sections not less than 36 feet wide. Test seams in accordance with method ASTM D4884. The strength of the seam shall be not less than 90 percent of the required grab tensile strength of the unaged geotextile in any principal direction.

2.1.3 Securing Pins

Secure the geotextile to the embankment soil by pins to prevent movement prior to placement of revetment materials. Other appropriate means to prevent movement such as staples, sand bags, and stone could also be used. Insert securing pins through both strips of overlapped geotextile along the line passing through midpoints of the overlap. Remove securing pins as placement of revetment materials are placed to prevent tearing of geotextile or enlarging holes. The maximum pins spacing shall be equal to or less than 2 feet. When windy conditions prevail at the construction site, increase the number of pins upon the demand of the OWNER. Loop the geotextile over the armor stone at the crest and toe of the slope and secure.

2.2 INSPECTIONS, VERIFICATIONS, AND TESTING

2.2.1 Manufacturing and Sampling

Geotextiles and factory seams shall meet the requirements specified in TABLE 1. Perform conformance testing in accordance with the manufacturers approved quality control manual.

2.2.2 Site Verification and Testing

Collect samples at approved locations upon delivery to the site in accordance with ASTM D4354 (Procedure Method B) at a frequency of once per 10,000 square yards. Test samples to verify that the geotextile meets the requirements specified in TABLE 1. Identify samples by manufacturer's name, type of geotextile, lot number, roll number, and machine direction. Perform testing at an approved laboratory. Submit test results from the lot under review for approval prior to deployment of that lot of geotextile. Rolls which are sampled shall be immediately rewrapped in their protective covering.

**PART 3 EXECUTION**

3.1 SURFACE PREPARATION

Prepare surface, on which the geotextile will be placed, to a relatively smooth surface condition in accordance with the applicable portion of this specification and shall be free from obstruction, debris, depressions, erosion feature, or vegetation. Remove any irregularities so as to ensure continuous, intimate contact of the geotextile with the entire surface. Any loose material, soft or low density pockets of material, shall be removed; erosion features such as rills, gullies etc. shall be graded out of the surface before geotextile placement.

3.2 INSTALLATION OF THE GEOTEXTILE

3.2.1 General

Place the geotextile in the manner and at the locations shown. At the time of installation, reject the geotextile if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.

3.2.2 Placement

Place the geotextile with the long dimension perpendicular to the shoreline and laid smooth and free of tension, stress, folds, wrinkles, or creases. Place the strips to provide a minimum width of 24 inches of overlap for each joint. Adjust the actual length of the geotextile used based on initial installation experience. Temporary pinning of the geotextile to help hold it in place until the armor stone is placed will be allowed. Remove the temporary pins as the armor stone is placed to relieve high tensile stress which may occur during placement of material on the geotextile. Loop the geotextile over the armor stone at the crest and toe of the slope and secure.

3.3 PROTECTION

Protect the geotextile at all times during construction from contamination by surface runoff; remove any geotextile so contaminated and replaced with uncontaminated geotextile. Replace any geotextile damaged during its installation or during placement at no cost to the OWNER. Schedule the work so that the covering of the geotextile with a layer of the specified material is accomplished within 7 calendar days after placement of the geotextile. Failure to comply shall require replacement of geotextile. Protect the geotextile

from damage prior to and during the placement of armor stone. This may be accomplished by limiting the height of drop to less than 1 foot, by placing a cushioning layer of sand or gravel on top of the geotextile before placing the material, or other methods deemed necessary. Care should be taken to ensure that the utilized cushioning materials will not impede the flow of water. Before placement of armor stone or other materials, demonstrate that the placement technique will not cause damage to the geotextile. In no case shall any type of equipment be allowed on the unprotected geotextile.

3.4 PLACEMENT OF CUSHIONING MATERIAL

Perform placing of cushioning material in a manner to ensure intimate contact of the geotextile with the prepared surface and with the cushioning material. The placement shall also be performed in a manner that will not damage the geotextile including tear, puncture, or abrasion. On sloping surfaces place the cushioning material from the bottom of the slopes upward. During placement, the height of the drop of riprap material shall not be greater than 12 inches. Uncover any geotextile damaged beneath the cushioning material, as necessary, and replaced at no cost to the OWNER.

3.5 OVERLAPPING

The overlap of geotextile panels shall be a minimum of 48 inches. Appropriate measures will be taken to ensure required overlap exists after cushion placement. Overlap shall not be within 10 feet of wrapping of armor stone.

END OF SECTION

# SECTION 311000 - SITE CLEARING

## PART 1-GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Protecting existing trees, shrubs, groundcovers, plants and grass to remain.
2. Removing existing trees, shrubs, groundcovers, plants and grass.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting and capping or sealing site utilities.
7. Temporary erosion and sedimentation control measures.

1.2 MATERIAL OWNERSHIP

A. Except for stripped topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site-clearing operations until temporary erosion and sedimentation control measures are in place.

## PART 2-PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Division 31 Section "Earth Moving."
1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

## PART 3-EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly flag trees and vegetation to remain or to be relocated.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to a sediment and erosion control plan, specific to the site, that complies with NPDES or requirements of authorities having jurisdiction, whichever is more stringent.

B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.

B. Do not excavate within tree protection zones, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Design Professional.

3.4 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
   1. Arrange with utility companies to shut off indicated utilities.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Design Professional not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Design Professional's written permission.

C. Removal of underground utilities in accordance with Miami-Dade Water and Sewer Department Specification.

3.5 CLEARING AND GRUBBING

A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

3.8 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
   1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

# SECTION 312000 - EARTH MOVING

## PART 1-GENERAL

1.1 SUMMARY

A. This Section includes the following:
1. Preparing subgrades for slabs-on-grade, walks, lawns and grasses and exterior plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subbase course for concrete walks.
5. Excavating and backfilling for utility trenches.
6. Soil Management

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving or concrete ravement.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Design Professional. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Design Professional. Unauthorized excavation, as well as remedial work directed by the Design Professional, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.3 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted in writing by the Design Professional and then only after arranging to provide temporary utility services according to requirements indicated.
B. Refer to soil management construction plans and soil management plan prepared by EE&G in Appendix to this section.

1.4 SUBMITTALS

A. Independent laboratory: Submit qualifications and experience of independent testing laboratory.
B. Materials: Submit sources of all materials.

**PART 2-PRODUCTS**

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 Soil Classification Groups GW, GP, GM, SW, SP, and SM or AASHTO M 145 Soil Classification Groups A-1, A-2-4, A-2-5, and A-3, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, vegetation and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145 or a combination of these groups.

D. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

E. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

F. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

J. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.

**PART 3-EXECUTION**

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing."

C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing," during earthwork operations.

3.2 EXCAVATION

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Excavate in accordance with soil management plans prior to project earth moving.

3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
   1. Clearance: 12 inches each side of pipe or conduit.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
   1. Excavate trenches 12 inches deeper than elevation required in rock or other unyielding bearing material.

3.6 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with heavy pneumatic tired equipment to identify soft pockets and areas of excess yielding. Do not proofroll wet or saturated subgrades. Use small hand-operated tampers adjacent to existing bulkhead.

B. Reconstruct subgrades damaged by rain, accumulated water, or construction activities, as directed by Design Professional, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Design Professional.
   1. Fill unauthorized excavations under other construction or utility pipe as directed by Design Professional.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.

D. Provide 8-inch thick, concrete slab over piping or conduit less than 30 inches below surface of roadways.

E. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy.
   2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 6 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 or ASTM D 1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 98 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 98 percent.
   3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
   4. For utility trenches, compact each layer of initial and final backfill soil material at 90 percent.
   5. Adjacent to bulkhead use hand-operated tampers so as not to stress sheet pile bulkhead.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1 inch.
   3. Pavements: Plus or minus 1/2 inch.

3.14 SUBBASE AND BASE COURSES

A. Place subbase and base course on subgrades free of mud.

B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
   1. Shape subbase and base course to required crown elevations and cross-slope grades.
   2. Compact subbase and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698 or ASTM D 1557.

3.15 DRAINAGE COURSE

A. Place drainage course on subgrades free of mud.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
   1. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. The Contractor will retain a firm for testing and evaluation in accordance with Soil Management Plan, located in Appendix B.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Design Professional.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained at no additional cost to the Owner.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

# SECTION 312100 – EARTHWORK FOR BUILDING

## 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. Excavating and filling for rough grading the Site.

2. Preparing subgrades for slabs-on-grade.

3. Excavating and backfilling for buildings and structures.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" and Section 013233 "Photographic Documentation" for recording pre-excavation and earth-moving progress.

2. Section 311000 "Site Clearing" for site stripping, grubbing, stripping, topsoil, and removal of above- and below-grade improvements and utilities.

### 1.3 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."

B. Quantity allowances for earth moving are included in Section 012100 "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

### 1.4 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, will be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock:

1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

a. Equipment for Footing and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom.

2. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

## 1.5 PREINSTALLATION MEETINGS

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

B. Retain subparagraph below if additional requirements are necessary; include information about conference.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.

b. Coordination of Work with utility locator service.

c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.

d. Extent of trenching by hand or with air spade.

e. Field quality control.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.

2. Laboratory compaction curve according to ASTM D698, ASTM D1557.

## 1.7 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

## 1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify [**utility locator service**] [**"Miss Utility"**] [**"Call Before You Dig"**] [**"Dig Safe System"**] [**"One Call"**] for area where Project is located before beginning earth-moving operations.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within 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.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

## PART 2 - PRODUCTS

### 2.1 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

1. Red: Electric.

2. Yellow: Gas, oil, steam, and dangerous materials.

3. Orange: Telephone and other communications.

4. Blue: Water systems.

5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

1. Red: Electric.

2. Yellow: Gas, oil, steam, and dangerous materials.

3. Orange: Telephone and other communications.

4. Blue: Water systems.

5. Green: Sewer systems.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

### 3.2 DEWATERING

A. Provide 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.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

## 3.3 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

## 3.4 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by EOR in writing.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by EOR in writing.

## 3.5 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

## 3.6 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation as indicated in Architectural Drawings.

2. Surveying locations of underground utilities for Record Documents.

3. Testing and inspecting underground utilities.

4. Removing concrete formwork.

5. Removing trash and debris.

6. Removing temporary shoring, bracing, and sheeting.

7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

C. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

D. Warning Tape: Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

## 3.7 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.

5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

## 3.8 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698 and ASTM D1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

## 3.9 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

## 3.10 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

2. Place drainage course 6 inches or less in compacted thickness in a single layer.

3. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

4. Compact each layer of drainage course to required cross sections and thicknesses to not less than 95 percent of maximum dry unit weight according to ASTM D698.

## 3.11 FIELD QUALITY CONTROL

A. Special Inspections: Contractor will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.

2. Determine that fill material classification and maximum lift thickness comply with requirements.

3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Contractor will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

## 3.12 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

## 3.13 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

**END OF SECTION 31 21 00**

# SECTION 316316 – AUGER CAST GROUT PILES

## 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 auger cast grout piles.

### 1.3 UNIT PRICES

A. Contract Sum: Base Contract Sum on number and dimensions of piles from tip to pile top.

B. Work of this Section is affected as follows:

1. Pile Length: Additional payment for pile lengths in excess of that indicated, and credit for pile lengths less than that indicated, is calculated at unit prices stated in the Contract, based on net addition or deduction to total pile length as determined by Architect and measured to nearest 12 inches.

2. Number of Piles: Additional payment for number of piles in excess of that indicated, and credit for number of piles less than that indicated, is calculated at unit prices stated in the Contract.

3. Unit prices include labor, materials, tools, equipment, and incidentals for excavation, grout fill, reinforcement, testing and inspection, and other items for complete pile installation.

4. Test piles that become part of permanent foundation system are considered as an integral part of the Work.

5. No payment is made for rejected piles, including piles out of specified tolerance or defective piles.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each grout mixture. Submit alternative design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Shop Drawings: For auger cast grout piles, prepared by or under the supervision of a qualified professional engineer.

1. Identify each pile and indicate pile dimensions, cross sections, locations, and sizes.

2. Indicate types and configurations of reinforcement and detail fabricating.

3. Detail connections to pile caps.

4. Include method of centralizing reinforcement, type and size of centralizing devices, and locations on reinforcing bars.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For the following:

1. Cementitious materials.

2. Concrete admixtures.

3. Steel reinforcing.

C. Equipment Data: Description of drilling and grout-pumping equipment including the following:

1. Type and make of drilling rig, rated capacity, and boom lengths.

2. Torque of drilling machine and horsepower of hydraulic power unit.

3. Pressure and discharge capacity of grout pump.

4. Automated monitoring equipment to be used.

D. Pile Inspection Reports: Submit not later than the morning of the next working day after placing each pile.

E. Field quality-control reports.

## 1.7 CLOSEOUT SUBMITTALS

A. Record Drawings.

B. Certified Pile Survey: Submit within seven days of pile installation completion.

## 1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1077, ASTM D3740, and ASTM E329 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025].

B. Mix Designs: For each type of grout. Include description of type and proportions of ingredients.

## 1.9 PRECONSTRUCTION TESTING

A. Test Piles: Construct of diameter, depth, and at locations indicated on Drawings or, if not indicated, of same diameter and depth as largest production piles and at locations selected by Architect, to confirm allowable load of piles and demonstrate Installer's construction methods, equipment, standards of workmanship, and tolerances.

1. If Architect determines that test pile does not comply with requirements, excavate for and cast another until it is accepted.

2. Tests: Arrange and perform the following pile tests:

a. Axial Compressive Static Load Test: ASTM D1143/D1143M, Procedure A, Quick Test and the following Procedures:

1) Procedure B, Maintained Test.

b. Axial Tension Static Load Test: ASTM D3689.

c. Lateral Load Test: ASTM D3966.

3. Equip each test pile with two telltale rods, according to ASTM D1143, for measuring deformation during load test.

4. Provide pile reaction frame, anchor piles, equipment, and instrumentation with enough reaction capacity to perform tests. Notify Architect at least 48 hours in advance of performing tests. On completion of testing, remove testing structure, anchor piles, equipment, and instrumentation.

a. Allow a minimum of seven days to elapse after installing test piles before starting pile testing.

b. Number of Test Piles: As indicated.

5. Approval Criteria: Allowable load shall be the load acting on the test pile when the lesser of the following criteria are met, divided by a factor of safety of 2:

a. Net settlement of not more than 0.01 inch/ton (0.25 mm/907 kg) of test load.

b. Total settlement of 1 inch (25 mm) provided the load settlement curve shows no sign of failure.

c. A plunging failure or sharp break in the load settlement curve.

6. Test Pile Records: Prepare records for each test pile, compiled and attested to by a qualified professional engineer. Include same data as required for permanent piles.

7. Test piles may not be used on Project.

### 1.10 FIELD CONDITIONS

A. Protect structures, underground utilities, and other construction from damage caused by pile excavation.

B. Site Information: A geotechnical report has been prepared for this Project and is referenced in the Project Manual for information only.

C. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for auger cast grout piles. Before excavating, lay out each pile to lines and levels required. Record actual measurements of each pile's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each pile and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

1. Design Loads: As indicated on Structural Drawings.

### 2.2 STEEL REINFORCEMENT

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

B. Single Bar Reinforcing: ASTM A722, high strength, threaded.

C. Centralizers: Devices to center steel reinforcement in excavation; spaced not less than 20 feet o.c. for vertical piles.

### 2.3 CONCRETE MATERIALS

A. Portland Cement: ASTM C150, Type I.

1. Fly Ash: ASTM C618, Class F.

B. Fine Aggregate: ASTM C33 with 100 percent passing a No. 8 sieve, free of materials with deleterious reactivity to alkali in cement. Provide aggregate from single source.

C. Water: ASTM C94 and potable.

D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.

E. Fluidifier: ASTM C937, with expansion of less than 4 percent.

**2.4 GROUT MIXTURES**

A. Prepare design mixtures for each type and strength of grout, proportioned on the basis of laboratory trial mixture, field test data, or both.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Proportion grout mixture as follows:

1. Minimum Compressive Strength: 5000 psi 28 days; ASTM C109 with cube specimens restrained from expansion according to ASTM C942.

2. Maximum Water-Cementitious Materials Ratio: 0.40

3. Grout Flow: 10 to 25 seconds ASTM C939 and ASTM C109 using a flow cone with 0.75-inch opening.

**2.5 FABRICATING REINFORCEMENT**

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

**2.6 GROUT MIXING**

A. Ready-Mixed Grout: Measure, batch, mix, and deliver according to ASTM C94, and furnish batch ticket information.

1. Temperature Limits: Comply with ACI 305.1 for hot weather and ACI 306.1 for cold weather.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, and other hazards created by drilling operations.

**3.2 DRILLING AND PUMPING EQUIPMENT**

A. Drilling Rig: Capable of advancing hollow-stem, continuous-flight augers of design diameters to depths 20 percent greater than design depths; with stabilizing arm at bottom of leads to prevent rotation, and middle guide for augers greater than 40 feet in length.

1. Mark leads at maximum 60-inch intervals to facilitate measurement of penetration.

B. Hollow-Stem Auger: Continuous auger flighting without gaps or breaks, of diameter no more than 3 percent less than pile diameter; with grout pumping hole at bottom of auger head below

cutting teeth. Seal grout-pumping hole with temporary tip plug to be fully opened by grout pressure or reinforcing bar during grout installation.

1. Hollow Shaft Diameter: Minimum 1-1/4-inch clear ID.

C. Grout Pump: Positive-displacement pump with a known volume per stroke. Minimum displacement pressure at pump of 350 lbf/sq. in.

D. Automated Monitoring Equipment: Capable of measuring auger depth, penetration rate, and grout volume pumped per unit depth increment and of printing results.

## 3.3 EXCAVATION

A. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

B. Advance auger at a continuous rate during insertion that prevents removal of excess soil.

C. Excavate piles to elevations indicated. Establish and maintain axial alignment of leads and shaft before and during driving.

D. Drilling Tolerances:

1. Location: Pile centers maximum 3 inches from locations indicated.

2. Plumb: Within 2 percent from vertical.

## 3.4 INSTALLATION

A. Maintain positive (clockwise) rotation of auger during withdrawal. Promptly remove excavated spoils to prevent accumulation.

B. Grout Placement: Place grout in continuous operation.

1. Lift auger 6 to 12 inches at start of grout pumping to facilitate tip plug removal, then return to previously established tip elevation.

2. Develop an initial grout head of 60 inches before start of auger withdrawal and maintain during extraction.

3. Monitor pumped grout volumes using automated monitoring equipment.

4. Volume of placed grout is at least 115 percent of theoretical volume. If less than required volume is placed for any given 60-inch segment, lower auger a minimum of 60 inches, or to bottom of pile if less than 60 inches available, and restart withdrawal.

5. If grout pumping is interrupted during placement, lower auger a minimum of 60 inches, or to bottom of pile if less than 60 inches available, and restart withdrawal.

C. Steel Reinforcement Installation, General: Comply with recommendations in CRSI's "Manual of Standard Practice."

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with grout.

2. Screen pile top to remove spoils immediately after auger withdrawal and before placing reinforcement.

D. Single Bar Reinforcing: Install through center of hollow-stem auger before grout placement.

E. Reinforcing Cages: Install immediately after grout placement and support at ground surface until initial set. Allow cages to fall into shaft freely under their own weight; do not force by vibrating or pushing with mechanical equipment.

F. Adjacent Piles: Do not install piles within 6 pile diameters (96 inches) of piles grouted within the previous 12 hours.

G. Pile Completion:

1. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation with pile-top form.

2. Where cutoff elevation is below the ground elevation, cut off top of piles at elevations indicated by removing fresh grout from the top of pile or cutting off hardened pile top after initial set.

H. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect for review before proceeding.

## 3.5 FIELD QUALITY CONTROL

A. Special Inspections: Contractor will engage and pay a qualified special inspector to perform the following special inspections:

1. Pile excavation, placement, and testing.

2. Steel reinforcement welding.

B. Testing Agency: Contractor will engage and pay a qualified testing agency to perform tests and inspections.

C. Grout Tests: Testing of samples of fresh grout obtained according to ASTM C172 shall be performed according to the following requirements:

1. Flow Rate: ASTM C939 and ASTM C109 using a flow cone with 0.75-inch opening.

2. Compressive Strength: ASTM C109 with cube specimens restrained from expansion according to ASTM C942.

a. Testing Frequency: Obtain (6) 2-inch cubes for each 50 cu. yd. or fraction thereof of grout placed, but not less than one set for each day's pour. Obtain an additional set of cubes from each truck during test pile placement.

b. Test two cubes at 7 days, two cubes at 28 days, and hold two cubes in reserve.

c. Strength of each grout mixture is 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. (f'c = 5000 psi at 28 days)

d. Report test results in writing to Architect, grout manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of placement, name of testing and inspecting agency, location of grout batch in Work, design compressive strength at 28 days, grout mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.

e. Additional Tests: Testing and inspecting agency to make additional tests of grout if test results indicate that compressive strengths or other requirements have not been met, as directed by Architect.

f. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

g. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Pile Inspection Reports: Prepare inspection reports for each auger cast grout pile as follows:

1. Pile location.

2. Pile diameter.

3. Actual top and bottom elevations.

4. Final top centerline location and deviations from requirements.

5. Variation from plumb.

6. Date and time of starting and completing.

7. Position and condition of reinforcing steel and splices or mechanical couplings.

8. Automatic monitoring equipment record including grout volume actually pumped.

9. Grout testing results.

10. Remarks, unusual conditions encountered, and deviations from requirements.

E. Certified Piles Survey: Prepared by a qualified land surveyor or professional engineer showing final location of piles in relation to the property survey and existing benchmarks.

1. Notify Engineer on Record when deviations from locations exceed allowable tolerances.

F. Auger cast grout piles will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

## 3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

**END OF SECTION 31 63 16**

# 320190 – TREE PROTECTION AND PRUNING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes the protection and pruning of trees that interfere with, or are affected by, execution of the Work, whether temporary or new construction.

### 1.2 REFERENCED STANDARDS

A. ANSI: American National Standards Institute
   1. ANSI A300, "Trees, Shrubs, and Other Woody Plant Maintenance--Standard Practices".

### 1.3 DEFINITIONS

A. Drip line: The outer extent of the canopy projected vertically onto the ground but not less than a radius of 8 foot.

B. Critical Root Zone (CRZ): Same as drip line as defined above.

### 1.4 ACTION SUBMITTALS

A. Examination Report: Prior to site work submit an examination report outlining the existing condition of the trees to be protected. Include photographs of each tree:
   1. Digital photographs in pdf or jpeg are preferred.
   2. Scale: Include a yardstick in each photograph to provide scale.
   3. Identification:
      a. Name of Project & Town.
      b. Date photograph was taken.
      c. Species name and number, corresponding to the drawings.

### 1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For firms and persons specified in "Quality Assurance" (1.6) to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Landscape Architects and Town, and other information specified.

B. Certification: From a qualified arborist that trees indicated to remain have been protected during construction according to recognized standards and that the trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From a qualified arborist for care and protection of trees affected by construction during and after completing the Work.

1.6 QUALITY ASSURANCE

A. Tree Service Qualifications: An experienced tree service firm that has successfully completed tree protection and pruning work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

B. Arborist Qualifications: An arborist certified by the International Society of Arboriculture or licensed in the jurisdiction where Project is located.

C. Pre-Construction Conference: Conduct conference at Project site with the Landscape Architect.
1. Before starting tree protection and pruning, meet with representatives of authorities having jurisdiction, the Town and Landscape Architect. Review tree protection and pruning procedures and responsibilities. Notify participants at least three working days before convening conference. Record discussions and agreements and furnish a copy to each participant.

1.7 DISPOSAL or STORAGE OF WASTE MATERIALS

A. Burning is not permitted.

B. Disposal: Remove excess excavated material, displaced trees, and excess chips from Town's property.

**PART 2 - PRODUCTS**

2.1 MATERIALS

A. Fencing: Orange plastic safety mesh, metal “T” bar stakes with tie wires, hog ring ties, and other accessories for a complete fence system, or as required by relevant authority.

B. Water: Potable.

C. Mulch: Mulch shall be processed entirely from the Melaleuca tree and composed of 97% hard inner wood and 3% outer bark. It shall be naturally colored, uniformly shredded and free from foreign matter, large pieces of bark, tree stump material, burrowing nematodes and ants. (Melaleuca mulch must have a written guarantee that there will be no germination of Melaleuca seed present in the mulch. If germination occurs, the Contractor shall be responsible for removal of the mulch and seedlings to the satisfaction of the Landscape Architect. The mulch shall be replaced with another acceptable mulch approved by the Landscape Architect).

**PART 3 - EXECUTION**

3.1 EXAMINATION

A. Prior to any on site construction work, examine, record and report on the condition of the existing trees. The submitted report shall be used as a basis to assess any future damage.

3.2 PREPARATION

A. Install temporary fencing located as indicated on plans or outside the drip line of the trees to protect remaining vegetation from construction damage. Fencing may be removed to accommodate necessary work within the drip line but shall be reinstalled at the end of each day until the work is complete. Remove fence upon project completion.

B. Protect tree root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.

C. Do not store construction materials, debris, or excavated material within the drip line of remaining trees. Do not permit vehicles or foot traffic within the drip line; prevent soil compaction over root systems. Do not discharge hot exhaust close to foliage.

D. Do not allow fires under or adjacent to remaining trees or other plants.

E. Protected trees shall be mulched using product per 2.1 C.

3.3 EXCAVATION

A. Install shoring or other protective support systems to minimize sloping or benching of excavations.

B. DO NOT excavate within drip line of trees, unless approved by the Landscape Architect before construction.

C. Where pre-approved excavation for new construction is required adjacent to existing trees, vary excavation methods to protect the root systems:
   1. Within the drip line, no excavation is permitted: Tunnel under roots by drilling, auger boring or pipe jacking.

   2. Outside drip line but inside the radius equal to the height of the tree: Machine excavation is permitted on a maximum of two sides of the tree if at least 6 inches of the trench wall is hand dug and the roots cut with sharp clean pruning instruments. Do not cut main lateral roots or taproots.

3.4 TREE PRUNING

A. Consult Landscape Architect when discussing crown clearing and raising. After verifying extent of pruning with Landscape Architect, execute Maintenance Pruning including Crown Cleaning and Crown Raising as defined by ANSI A300.

B. Pruning Standards: Prune trees according to ANSI A300.

C. Chip branches removed from trees. All chipped materials shall be removed off-site and disposed of in the proper site for the materials.

D. Provide subsequent maintenance during Contract period as recommended by qualified arborist.

E. No tree/branch paint shall be applied to pruned branches.

3.5 TREE REPAIR AND REPLACEMENT

A. Be responsible for all damage from works under this contract and all damage from works by others if trees were not protected as documented. The contractor shall not be responsible for damage by others if the trees were protected as documented.

B. For minor repairable damage: Promptly repair trees within 24 hours. Treat damaged trunks, limbs, and roots according to written instructions of the qualified arborist.

C. For compacted soil:

1. Aerate surface soil 10 feet (3 m) beyond drip line and no closer than 36 inches (900 mm) to tree trunk. Drill 2-inch- (50-mm-) diameter holes a minimum of 12 inches (300 mm) deep at 24 inches (600 mm) o.c. Backfill holes with an equal mix of augered soil and sand.

D. For major damage and/or death of trees under 6-inch caliper (measured 6 inches (150 mm) above grade):

1. Remove and replace with new trees of 6-inch (150-mm) caliper size and of a species selected by the Landscape Architect.

**END OF SECTION**

## SECTION 321123 - COARSE AGGREGATE

### PART 1 GENERAL

1.1 COMPOSITION

A. Coarse aggregate shall consist of naturally occurring materials such as gravel, or resulting from the crushing of parent rock, to include natural rock, slags, expanded clays and shales (lightweight aggregates) and other approved inert materials with similar characteristics, having hard, strong, durable particles, conforming to the specific requirements of this Section.

B. Materials substantially retained on the No. 4 sieve, shall be classified as coarse aggregate.

C. Approval of mineral aggregate sources shall be in accordance with 6-2.3.

1.2 DELETERIOUS SUBSTANCES

A. All coarse aggregates shall be reasonably free of clay lumps, soft and friable particles, salt, alkali, organic matter, adherent coatings, and other substances not defined which may possess undesirable characteristics. The weight of deleterious substances shall not exceed the following percentages:

| | |
|---|---|
| Coal and lignite (AASHTO T-113) | 1.00 |
| Soft and friable particles (AASHTO T-112)* | 2.00 |
| Clay lumps (AASHTO T-112)* | 2.00 |
| Plant root matter (visual inspection in AASHTO T-27)**** | 0.005 |
| Wood and wood matter (visual inspection in AASHTO T-27)**** | 0.005 |
| Cinders and clinkers | 0.50 |
| Free shell** | 1.00 |
| Total Material passing the No. 200 sieve (FM 1-T011) | |
| At Source with Los Angeles Abrasion less than or equal to 30 | 2.50 |
| At Source with Los Angeles Abrasion greater than 30 | 1.75 |
| At Point of Use | 3.75 |
| Fine-Grained Organic Matter (AASHTO 194) | 0.03 |
| Chert (less than 2.40 specific gravity SSD) (AASHTO T-113)*** | 3.00 |

* The maximum percent by weight of soft and friable particles and clay lumps together shall not exceed 3.00.

** Aggregates to be used in asphalt concrete may contain up to 5% free shell. Free shell is defined as that portion of the coarse aggregate retained on the No. 4 sieve consisting of loose, whole, or broken shell, or the external skeletal remains of other marine life, having a ratio of the maximum length of the particle to the shell wall thickness exceeding five to one. Coral, molds, or casts of other shells, and crushed clam and oyster shell indigenous to the formation will not be considered as free shell.

*** This limitation applies only to coarse aggregates in which chert appears as an impurity. It is not applicable to aggregates which are predominantly chert.

**** Plant root matter, and wood and wood matter shall be considered deleterious when any piece exceeds two inches in length or 1/2 inch in width.

B. The weights of deleterious substances for reclaimed Portland cement concrete aggregate shall not exceed the following percentages:

Bituminous Concrete .....1.00

Bricks .....1.00

Wood and other organic substances (by weight)***** ....0.1

Reinforcing Steel and Welded Wire Reinforcement.....0.1

Plaster and gypsum board .....0.1

Joint Fillers .....0.1

***** Supersedes requirement for other coarse aggregate

1.2 PHYSICAL PROPERTIES

A. Coarse aggregates shall meet the following physical property requirements, except as noted herein:

Los Angeles Abrasion (FM 1-T096).....maximum loss 45%

Soundness (Sodium Sulfate) AASHTO T104 .....

.....maximum loss 12%*

Flat or elongated pieces**.....maximum 10%

* For source approval - aggregates exceeding soundness loss limitations will be rejected unless performance history shows that the material will not be detrimental for portland cement concrete or other intended usages.

** A flat or elongated particle is defined as one having a ratio between the maximum and the minimum dimensions of a circumscribing prism exceeding five to one.

1.3 GRADATION

A. Coarse aggregates shall conform to the gradation requirements of Table 1, when the stone size is specified. However, Table 1 is waived for those aggregates intended for usage in bituminous mixtures, provided the material is graded on sieves specified in production requirements contained in 6-2.3, and meets uniformity and bituminous design requirements.

| TABLE 1<br>Standard Sizes of Coarse Aggregate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Amounts Finer than Each Laboratory Sieve (Square Openings), weight percent | | | | | | | | |
| Size No. | Nominal Size Square Openings | 4 inches | 3 1/2 inches | 3 inches | 2 1/2 inches | 2 inches | 1 1/2 inches | 1 inch |
| 1 | 3 1/2 to 1 1/2 inches | 100 | 90 to 100 | - | 25 to 60 | - | 0 to 15 | - |
| 2 | 2 1/2 inches to 1 1/2 inches | - | - | 100 | 90 to 100 | 35 to 70 | 0 to 15 | - |
| 24 | 2 1/2 inches to 3/4 inch | - | - | 100 | 90 to 100 | - | 25 to 60 | - |
| 3 | 2 inches to 1 inch | - | - | - | 100 | 90 to 100 | 35 to 70 | 0 to 15 |

| TABLE 1 (Continued)<br>Standard Sizes of Coarse Aggregate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Amounts Finer than Each Laboratory Sieve (Square Openings), weight percent | | | | | | | | |
| Size No. | Nominal Size Square Openings | 4 inches | 3 1/2 inches | 3 inches | 2 1/2 inches | 2 inches | 1 1/2 inches | 1 inch |
| 357 | 2 inches to No. 4 | - | - | - | 100 | 95 to 100 | - | 35 to 70 |
| 4 | 1 1/2 inches to 3/4 inch | - | - | - | - | 100 | 90 to 100 | 20 to 55 |
| 467 | 1 1/2 inches to No. 4 | - | - | - | - | 100 | 95 to 100 | - |
| 5 | 1 inch to 1/2 inch | - | - | - | - | - | 100 | 90 to 100 |
| 56 | 1 inch to 3/8 inch | - | - | - | - | - | 100 | 90 to 100 |
| 57 | 1 inch to No. 4 | - | - | - | - | - | 100 | 95 to 100 |
| 6 | 3/4 inch to 3/8 inch | - | - | - | - | - | - | 100 |
| 67 | 3/4 inch to No. 4 | - | - | - | - | - | - | 100 |
| 68 | 3/4 inch to No. 8 | - | - | - | - | - | - | - |
| 7 | 1/2 inch to No. 4 | - | - | - | - | - | - | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 78 | 1/2 inch to No. 8 | - | - | - | - | - | - | - |
| 8 | 3/8 inch to No. 8 | - | - | - | - | - | - | - |
| 89 | 3/8 inch to No. 16 | - | - | - | - | - | - | - |
| 9 | No. 4 to No. 16 | - | - | - | - | - | - | - |
| 10 | No. 4 to 0 | - | - | - | - | - | - | - |

TABLE 1 (Continued)
Standard Sizes of Coarse Aggregate

| Amounts Finer than Each Laboratory Sieve (Square Openings), weight percent | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Size No. | Nominal Size Square Openings | 3/4 inch | 1/2 inch | 3/8 inch | No. 4 | No. 8 | No. 16 | No. 50 |
| 1 | 3 1/2 inches to 1 1/2 inches | 0 to 5 | | - | 100 | | - | 35 to 70 |
| 2 | 2 1/2 inches to 1 1/2 inches | 0 to 5 | | - | - | | 90 to 100 | 20 to 55 |
| 24 | 2 1/2 inches to 3/4 inch | 0 to 10 | 0 to 5 | | | | | |
| 3 | 2 inches to 1 inch | - | 0 to 5 | | | | | |
| 357 | 2 inches to No. 4 | - | 10 to 30 | - | 0 to 5 | | | |
| 4 | 1 1/2 inches to 3/4 inch | 0 to 15 | - | 0 to 5 | | | | |
| 467 | 1 1/2 inches to No. 4 | 35 to 70 | - | 10 to 30 | 0 to 5 | | | |

TABLE 1 (Continued)
Standard Sizes of Coarse Aggregate

| Amounts Finer than Each Laboratory Sieve (Square Openings), weight percent | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Size No. | Nominal Size Square Openings | 3/4 inch | 1/2 inch | 3/8 inch | No. 4 | No. 8 | No. 16 | No. 50 |
| 5 | 1 inch to 1/2 inch | 20 to 55 | 0 to 10 | 0 to 5 | | | | |
| 56 | 1 inch to 3/8 inch | 40 to 85 | 10 to 40 | 0 to 15 | 0 to 5 | | | |
| 57 | 1 inch to No. 4 | - | 25 to 60 | - | 0 to 10 | 0 to 5 | | |
| 6 | 3/4 inch to 3/8 inch | 90 to 100 | 20 to 55 | 0 to 15 | 0 to 5 | | | |
| 67 | 3/4 inch to No. 4 | 90 to 100 | - | 20 to 55 | 0 to 10 | 0 to 5 | | |
| 68 | 3/4 inch to No. 8 | 90 to 100 | - | 30 to 65 | 5 to 25 | 0 to 10 | 0 to 5 | |
| 7 | 1/2 inch to No. 4 | 100 | 90 to 100 | 40 to 70 | 0 to 15 | 0 to 5 | | |
| 78 | 1/2 inch to No. 8 | 100 | 90 to 100 | 40 to 75 | 5 to 25 | 0 to 10 | 0 to 5 | |
| 8 | 3/8 inch to No. 8 | - | 100 | 85 to 100 | 10 to 30 | 0 to 10 | 0 to 5 | |
| 89 | 3/8 inch to No. 16 | - | 100 | 90 to 100 | 20 to 55 | 0 to 30 | 0 to 10 | 0 to 5 |
| 9 | No. 4 to No. 16 | - | - | 100 | 85 to 100 | 10 to 40 | 0 to 10 | 0 to 5 |
| 10 | No. 4 to 0 | - | - | 100 | 85 to 100 | - | - | - |

B. The gradations in Table 1 represent the extreme limits for the various sizes indicated which will be used in determining the suitability for use of coarse aggregate from all sources of supply. For any grade from any one source, the gradation shall be held reasonably uniform and not subject to the extreme percentages of gradation specified above.

**PART 2 NATURAL STONES**

A. Coarse aggregate may be processed from gravels, granites, limestones, dolomite, sandstones, or other naturally occurring hard, sound, durable materials meeting the requirements of this Section.

2.1 GRAVELS

A. Gravel shall be composed of naturally occurring quartz, free from deleterious coatings of any kind. The minimum dry-rodded weight AASHTO T-19 shall be 95 pounds per cubic foot.

B. Crushed gravel shall consist of a minimum of 85%, by weight, of the material retained on the No. 4 sieve, having at least three fractured faces.

2.2 GRANITES

A. Coarse aggregate produced from the crushing of granites shall be sound and durable. For granites to be used in bituminous mixtures and surface treatments, the Los Angeles Abrasion requirement of 901-1.3 is modified to permit a maximum loss up to 50 (FM 1-T096). Maximum amount of mica schist permitted is 5% (FM 5-584).

2.3 LIMESTONES, DOLOMITE AND SANDSTONE

A. Coarse aggregates may be produced from limestone, dolomite, sandstones, and other naturally occurring hard, durable materials meeting the requirements of this Section. When used as a friction course, crushed limestone shall have a minimum acid insoluble content of 12% (FM 5-510). Other materials must meet the approval requirements for friction course determined by Rule 14-103.005(1), Florida Administrative Code (FAC).

B. Pre-Cenozoic limestones and dolomite shall not be used as crushed stone aggregates either coarse or fine for asphalt concrete friction courses, or any other asphalt concrete mixture or surface treatment serving as the final wearing course. This specifically includes materials from the Ketone Dolomite (Cambrian) Newala Limestone (Mississippian) geologic formations in Northern Alabama and Georgia.

C. As an exception to the above, up to 20% fine aggregate from these materials may be used in asphalt concrete mixtures other than friction courses which serve as the final wearing course.

2.4 CEMENTED COQUINA ROCK

A. For cemented coquina rock to be used in bituminous mixtures, the Los Angeles Abrasion requirement of 901-1.3 is modified to permit a maximum loss up to 50 (FM 1-T 096) provided that the amount of material finer than No. 200 generated during the Los Angeles Abrasion test is less than 18%.

PART 3 MANUFACTURED STONES

3.1 SLAGS

A. Coarse aggregate may be produced from molten nonmetallic by-products consisting essentially of silicates and aluminosilicates of calcium and other bases, such as air-cooled blast-furnace slag or phosphate slag, provided it is reasonably uniform in density and quality, and reasonably free from deleterious substances as specified in 901-1.2. In addition, it must meet the following specific requirements:

Sulphur content ..... not more than 1.5%

Dry rodded weight AASHTO T-19 ..... minimum 70 $lb/ft^3$

Glassy Particles ..... not more than 10%

B. Slag shall not be used as an aggregate for Portland cement concrete.

C. For air-cooled blast furnace slag, the Los Angeles Abrasion requirement of 901-1.3 is modified to permit a maximum loss up to 50 (FM 1-T096) provided that the amount of material finer than No. 200 sieve generated during the Los Angeles Abrasion test is less than 18%.

## PART 4 LIGHTWEIGHT AGGREGATES

4.1 LIGHTWEIGHT COARSE AGGREGATE FOR BITUMINOUS CONSTRUCTION

A. Lightweight coarse aggregate may be produced from naturally occurring materials such as pumice, scoria, and tuff or from expanded clay, shale or slate fired in a rotary kiln. It shall be reasonably uniform in quality and density, and free of deleterious substances as specified in 901-1.2, except that the term cinders and clinkers shall apply to those particles clearly foreign to the extended aggregate in question.

B. In addition, it must meet the following specific requirements:

Material passing the No. 200 Sieve..... maximum 3.00%, (FM 1-T011)

Dry loose weight (AASHTO T-19)* ..... 33-55 lb/ft$^3$

Los Angeles Abrasion (FM 1-T096) . maximum 35%

Ferric Oxide (ASTM C641) ..... maximum 1.5 mg

* Source shall maintain dry-loose unit weight within plus or minus 6% of Quality Control average. Point of use dry-loose unit weight shall be within plus or minus 10% of Source Quality Control average.

4.2 LIGHTWEIGHT COARSE AGGREGATE FOR STRUCTURAL CONCRETE

A. The requirements of 901-4.1 are modified as follows:

B. Aggregates shall not be produced from pumice and scoria.

C. Los Angeles Abrasion (FM 1-T096, Section 12) shall be 45%, maximum.

D. Gradation shall meet the requirements of AASHTO M-195 for 3/4 inch, 1/2 inch and 3/8 inch.

## PART 5 RECYCLED CONCRETE AGGREGATE (RCA)

A. RCA shall be crushed and processed to provide a clean, hard, durable aggregate having a uniform gradation free from adherent coatings.

B. RCA can be used as coarse aggregate in pipe backfill under wet conditions, underdrain aggregate, or concrete meeting the requirements of Section 347. RCA can only be used in bituminous mixtures if the RCA originated from a concrete mix which was produced and placed in accordance with Section 346. RCA shall be asbestos free.

C. The Contractor's (Producer's) crushing operation shall produce an aggregate meeting the applicable gradation requirement. The physical property requirements of 901-1.3 for soundness shall not apply and the maximum loss as determined by the Los Angeles Abrasion (FM 1-T096) is changed to 50.

D. The sources of reclaimed portland cement concrete will be treated as a mine and subject to the requirements of Section 6 and Section 105.

**PART 6 EXCEPTIONS, ADDITIONS AND RESTRICTIONS**

A. Pertinent specification modifications, based on material usage, will be found in other Sections of the specifications.

END OF SECTION

# SECTION 321243 – FIBER REINFORCED SOD

## PART 1 - GENERAL

### 1.1 SUMMARY

A. This Section includes material and labor requirements for construction with sand mixed with stabilizing fiber in sod fire lanes.

B. Related Sections:

1. Section 02100 – Site Preparation
2. Section 02200 – Earthwork
3. Section 02230 – Granular Materials

### 1.2 SUBMITTALS

A. Shop Drawings: Show details of installation, including plans and sections.

### 1.3 PROJECT/SITE CONDITIONS

A. Field Measurements: Each bidder is required to visit the site of the Work to verify the existing conditions. No adjustments will be made to the Contract Sum for variations in the existing conditions.

1. Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.

B. Environmental Limitations: Do not install fiber reinforced sand and sod during rainy or windy conditions.

### 1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer to provide evidence to indicate successful experience in installing fiber reinforced sand and sod.

B. Mock-ups: Install 4 ft. wide x 10 ft. long mock-up of sand mix stabilized with reinforcing fiber at location as directed by Town.

C. General Warranty: The special warranty specified in this Article shall not deprive the Town of other rights the Town may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

D. Special Warranty: Submit a written warranty executed by the installer agreeing to repair or replace components of stabilized surfacing that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, the following:

1. Premature wear and tear, provide the material is maintained in accordance with manufacturer's written maintenance instructions.
2. Failure of system to meet performance requirements.

E. Warranty Period: Contractor shall provide warranty for performance of product. Contractor shall warranty installation of product for the time of one year from completion.

F. Contractor shall provide, for a period of sixty days, unconditional maintenance and repairs as required.

**PART 2 -** PRODUCTS

2.1 MANUFACTURERS

A. StaLok Fiber provided by the following manufacturer:

1. Stabilizer Solutions, Inc. 33 South 28th St., Phoenix, AZ 85034; phone (602) 225-5900, (800) 336-2468; fax (602) 225-5902; website stabilizersolutions.com; email info@stabilizersolutions.com

2. ALTERNATE: TurfGrids provided by FiberSoils, PO Box 80198, Baton Rouge, LA 70898. Phone (866) 342-3771; (225) 757-9136; fax (225) 752-7975; website http://www.fibersoils.com/index.html; email moreinfo@fibersoils.com

2.2 MATERIALS

A. StaLok Fiber G-400

1. Acceptable local supplier list to be provided by Stabilizer Solutions, Inc.

B. Soil Mix

1. Sand must meet the particle size and physical performance criteria as shown in Section C below. Recommended tests include: grain size analysis, percentage of sand, silt and clay constituents, saturated hydraulic conductivity and porosity (including total, air-filled, and capillary pore space), and bulk density. Calculate values for fineness modulus and uniformity coefficient. An approved construction materials testing laboratory should test representative samples from the material source. In addition, samples should be tested for pH. Recommendations should include the need for organic amendments to meet performance criteria. Sand tested should be available in sufficient quantities for project.

2. Quality control testing should be performed for every 500-tons of soil delivered to site. Cost is contractor's responsibility. Soils not meeting requirements must be removed and replaced at contractor's expense.

3. No truck traffic permitted over installation area until final placement and compaction is completed.

C. Soil Mix for Stabilized Rootzone (Sand / Peat Blend)

1. Particle Size Criteria for Sand

| USDA PARTICLE NAME | US STANDARD SIEVE NUMBER | | DIAMETER OF PARTICLE IN MILLIMETERS | ALLOWABLE RANGE % RETAINED |
|---|---|---|---|---|
| GRAVEL | 6 | | 3.35 | 0 |
| FINE GRAVEL | 10 | | 2.000 – 3.35 | 0 No More |
| VERY COARSE SAND | 18 | | 1.000 – 2.00 | <5% than 10 combined |
| COARSE SAND | 35 | | 0.500 – 1.00 | <25% |
| MEDIUM SAND | 60 | | 0.250 – 0.50* | 50% - 90% |
| FINE SAND | 100 | | 0.100 – 0.25 | <15% |
| VERY FINE SAND | 270 | | 0.050 – 0.10 | <5% |
| SILT | | | 0.002 – 0.05 | <5% |
| CLAY | | | <0.002 | <3% |
| * In addition, not more than 20% below 0.25 mm | | | | |

2. Physical Performance Criteria

| | | | |
|---|---|---|---|
| Fineness Modulus: | 1.4 – 2.0 | Total Porosity: | 35% - 55% |
| Uniformity Coeffi-cient: | < 4 (2.5 – 3.5) | Air Filled Porosity: | 20% - 30% |
| Capillary Porosity: | 15% - 25% | Saturated Hydraulic Conductivity: | 5” – 15” per hour |

3. Blended rootzone mix should have a pH between 5.5 and 7.0. Recommended blend for rootzone soil mix and sod topping is 90% sand and 10% peat by volume. Peat should have a pH not less than 5, be of medium grade, and have organic content of not less than 90% (L.O.I.).
4. With proper sub-base StaLok Fiber test results have shown support of a 60,000lb load per square foot.

D. Equipment

1. Approved rototiller, reverse tiller is preferred (Incorporator, Rotodairon, Blecavator, or equivalent).

2.3 EXCESS MATERIALS

A. Provide Town with the following excess materials for use in future: 40 to 50 lb. Bags of the sand mix blended with proper amount of StaLok Fiber.

**PART 3 -** EXECUTION

3.1 SUB-BASE INSTALLATION

A. Grade and compact sub-base to 95% compaction (ASTM D698). Surface must be smooth, no wheel ruts.

B. Install 3-inch (7.6-cm) minimum gravel drainage layer over sub-base and incorporate approved drainage system as determined by site specifications.

3.2 ROOTZONE MEDIUM

A. Install a 10-inch (25.4-cm) minimum of approved rootzone medium with loader or dozer. Avoid leaving ruts in the gravel base.

B. Rootzone medium should be water-settled and fine graded.

C. Rootzone medium should be consolidated with roller to dry density, between 87-lbs and 100-lbs per cubic foot. Maintain moisture content between 8% and 10% during install.

D. Spread soil amendments and fertilizer before spreading fibers.

3.3 FIBER INSTALLATION

A. Place bags of fibers approximately 15-ft by 15-ft grid.

B. Spread fibers by hand or with a modified straw blower at a rate of approximately or 1-lb per 10-sqft for turf paving. (See section 1.2)

C. Mix fiber into rootzone to specified depth (generally 4-inches (12.7-cm) for turf paving using approved rototiller, a reverse tiller is highly recommended. (See section 2.2 MATERIALS). When using Rotodairon or Blecavator, 3 passes in different directions are generally sufficient. Other tillers may require up to 5 passes. Do not exceed 5 passes.

D. Check rate of fibers per square foot during application by placing 1-square yard sheets of plastic at random locations over the area. After spreading, remove sheets and weigh retained fibers to make sure proper weight is achieved. Continuous monitoring should be done to verify spreading rate matches design rate.

E. Strong winds may require wetting area of soil and fibers to reduce fiber displacement.

3.4 WATERING / CONSOLIDATION

A. Thoroughly soak surface after tilling. Soil should be moistened to minimum depth of 9-inches (23cm) and kept moist.

B. Consolidate with vibratory roller to dry density between 87 and 100-lbs per cubic foot. For high or low areas, or irregularities hand-rake to final grade and re-roll.

C. Surface is ready for planting with seed, stolons, or sod. If using sod, match soil type with soil medium.

3.5 MAINTENANCE

A. Maintain same as normally for un-stabilized grass areas.

3.6 REPAIRS

A. If sand mix with StaLok Fiber is removed and discarded, replace with excess material (see 2.3).

B. Repair grass area same as normally for un-stabilized grass areas.

**END OF SECTION**

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**SECTION 321313 – CONCRETE PAVEMENT**

**WITH INTEGRAL COLOR AND SHELL AGGREGATE**

**PART 1 - GENERAL**

1.1 SCOPE

A. The work shall include all labor, material, equipment and transportation required to finish the decorative concrete as shown in the Drawings. The Contractor shall be required to provide a foreman or supervisor who has built at least three such installations of high quality in the last three years.

1.2 RELATED WORK

A. Section 033000 – Cast-in-place Concrete

1.3 THIS WORK INCLUDES:

A. Installation of integrally colored concrete with shell aggregate.

B. Apply specified texture and cure concrete as per Section 033000 – Cast-in-Place Concrete

C. Perform final clean up.

1.4 CONTRACTOR QUALIFICATIONS

A. The Contractor shall have experience on a minimum of 3 completed projects with similar finishes specified herein.

1.5 SUBMITTALS

A. 10-LB sample of exposed aggregate shell.

B. SAMPLE PAVING PANEL
1. At a location to be approved by the Landscape Architect, the Contractor shall construct a sample panel no less than 8’ x 8’ and large enough to demonstrate proposed concrete colors and finishes for the final installation.
2. For accurate color, the quantity of colored concrete mixed should not be less than one-third of the capacity of the mixing drum and should always be in full yard increments.
3. Allow time for color review after 28 day curing period.
4. For seashell aggregate finishes, split mockup areas into three 4’ x 4’ areas with specified aggregate in middle zone and with a heavier and lighter version of specified aggregates in other two zones.
5. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.

6. Demolish and remove approved mockups from the site when directed by Landscape Architect.

**PART 2 - PRODUCTS**

2.1 MATERIALS

A. Concrete mix design: Refer to Division 3 Concrete, Section 033000 – Cast-in-Place Concrete

B. 100% White cement

2.2 CONCRETE COLOR

A. Scofield Chromix Admixture color-conditioned, water-reducing concrete. Color TBD.

2.3 CONCRETE MIXES

A. Proportion mixes to provide "tabby" seashell concrete with the following properties:
1. Compressive Strength (28 Days): 3500 psi
2. Maximum Water-Cementitious Materials Ratio: 0.63
3. Unit weight: 139 lbs/cf.
4. Slump Limit: -5-/+1 inches
5. Air: 4% +/- 1.5%

2.4 SURFACE TEXTURE

A. Exposed "tabby" shell aggregate

2.5 CONCRETE SEALER

A. Concrete sealer shall be Scofield Cementone Clear Sealer or approved equal.

**PART 3 - EXECUTION**

3.1 INSTALLATION PROCESS

A. All applicable sections of Section 033000 – Cast-in-Place Concrete shall apply for decorative concrete installation.

3.2 SPECIAL CONCRETE FINISHES

A. Exposed shell aggregate finish
   1. Broadcast sifted and washed “tabby” shells into mix design
   2. Saw cut areas in predetermined sized within 24 hours
   3. Without dislodging aggregate, mist-blast to remove appropriate concrete paste
   4. Fine-spray surface with water and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required. Comply with tolerances of ACI 117.
   5. Seal with penetrating seal.

B. Acceptable Installer, or approved equal: Connery Concrete, which is located at: 946 Beachland Blvd #2, Vero Beach, FL 32963; Tel: 772-231-1224

3.3 CLEAN-UP

A. Contractor shall clean concrete surfaces and remove all expended abrasive grit, concrete dust and debris at the end of each day of blasting operations and all other areas impacted by the Work in this Section.

**END OF SECTION**

## SECTION 02770 - CONCRETE SIDEWALKS AND CURBS

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M 182 | (1991) Burlap Cloth Made from Jute or Kenaf |

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

| | |
|---|---|
| ASTM A 185 | (1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement |
| ASTM C 31/C 31M | (1996) Making and Curing Concrete Test Specimens in the Field |
| ASTM C 143 | (1990a) Slump of Hydraulic Cement Concrete |
| ASTM C 171 | (1997) Sheet Materials for Curing Concrete |
| ASTM C 172 | (1997) Sampling Freshly Mixed Concrete |
| ASTM C 173 | (1996) Air Content of Freshly Mixed Concrete by the Volumetric Method |
| ASTM C 231 | (1997) Air Content of Freshly Mixed Concrete by the Pressure Method |
| ASTM C 309 | (1997) Liquid Membrane-Forming Compounds for Curing Concrete |
| ASTM C 920 | (1995) Elastomeric Joint Sealants |
| ASTM D 1751 | (1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) |
| ASTM D 1752 | (1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction |
| ASTM D 3405 | (1996) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements |

1.2 SUBMITTALS

Submit the following in accordance with Section entitled, "Submittal Procedures," in the General Conditions of the Contract.

Product Data

Concrete Mix Designs

Submit mix designs for all concrete including path, walls/footings and curbs.

Color Concrete

Submit color technical data and samples.

Delivery Tickets

Copies of certified delivery tickets for all concrete used in the construction.

Column Shower

Submit products and technical information for shower piping, fittings and appurtenances.

Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

Qualifications

Commercial laboratory for materials testing.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 95 degrees F at any time.

1.4 EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as

specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Owner shall have access at all times to the equipment to ensure proper operation and compliance with specifications.

1.4.2 Slip Form Equipment

Slip form curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

## PART 2 PRODUCTS

2.1 DIMENSIONS

Width and depth as shown on the drawings; radius of curve is 160 feet or less, cut walk to fit curvature shown. Cut ends to radial lines allowing no more than 5/8 – inch joint space after abutment.

2.2 PATH CONCRETE

Provide Rinker Materials mix 1293524 (RM, 4000,PAV) or approved equivalent.

a. Strength
    1. Compressive strength at 4,000 psi at twenty-eight (28) days.
    2. Flexural strength of 550 psi at twenty-eight (28) days.

b. Manufacture and Delivery
   Measurement of materials, batching, mixing, transporting, and delivery shall be as specified in ASTM C94-84. Discharge concrete into forms within 1-½ hours after introduction of water to cement. When temperature of concrete is 85 degrees F or above, the time between introduction of water to cement and complete discharge of concrete into forms shall not exceed 45 minutes.

c. Air Entraining Admixture
   ASTM C260-77

d. Water reducing admixtures conforming to ASTM C494-82 or ASTM C618-84 may be proposed for use at the Contractor option.

e. Color Additive
    1. Sidewalk: Pigment for integral coloration of concrete mix.

2.3 EXPANSION JOINT FILLERS

ANSI/ASTM D994-71, preformed bituminous type, ¼-thick.

2.4 CURING COMPOUND

ASTM C309-91, Type 1.

2.5 CURING MATERIAL

Waterproof paper, polyethylene sheet, clean burlap, cotton mats, or other approved material, free of substances that may cause stain or discoloration.

2.6 CURB CONCRETE

FDOT approved mix for 4,000-psi concrete. No color required

2.7 CAST – IN- PLACE CONCRETE

FDOT approved mix for extremely harsh environment; 4,000-psi

2.8 REINFORCED STEEL

In accordance with FDOT Specification, Section 415.

**PART 3 EXECUTION**

3.1 SUBGRADE PREPARATION

3.1.1 Path Base

Prepare cement-stabilized base in accordance with Section 02711.

3.1.2 Curb Subgrade (paver areas)

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Curb Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Survey layout information for the color pavement “swirl” is included in the plans. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10-foot long section. After forms are set, grade and alignment shall be checked with a 10-foot straightedge. Forms shall have a transverse slope as indicated with the low side adjacent to the roadway or landward side of the path. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

Concrete sidewalk placement and color shall be in accordance with the City of Miami Beach Public Works Department.

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straight edging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 1/8 inch. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators.

3.4.2 Reinforcement Steel Placement

Reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed. Reinforcement shall conform to FDOT Section 415.

3.4.3 Curb Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.4 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The top of the curb shall be rounded with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the curb top.

3.4.5 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.6 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 5 feet on centers, whichever is less (but not to exceed 25 square feet), and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 10 feet or more in width or as directed in the plans for the path. Transverse expansion joints shall be installed at sidewalk and path returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features, which project through or into the sidewalk pavement or path, using joint filler of the type, thickness, and width indicated.

3.5.1 Sidewalk Contraction Joints

Sawed joints shall be constructed within twelve (12) hours of concrete replacement by sawing a groove in the concrete with a 1/8-inch blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Expansion joints shall be formed with ½ inch joint filler strips. Joint filler shall be placed with top edge 1/4 inch below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 1/8 inch, and concrete over the joint filler shall be removed.

At the end of the curing period, expansion joints shall be cleaned and filled with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

## 3.6 CURB JOINTS

Curb joints shall be constructed at right angles to the line of curb.

### 3.6.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length. Contraction joints shall be constructed by means of 1/8-inch thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

### 3.6.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least ½ inch in width shall be provided at intervals not exceeding 5 feet. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 1-inch depth of curb contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 50 degrees F at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

## 3.7 CURING AND PROTECTION

### 3.7.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least three (3) days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

### 3.7.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.8 CAST – IN- PLACE CONCRETE

Cast concrete in accordance with FDOT Specification, Section 346.

3.9 COLUMN SHOWER INSTALLATION PER PLANS

3.10 GENERAL REQUIREMENTS

The Contractor shall employ an approved independent commercial laboratory to perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.10.1 Concrete Testing

3.10.1.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 250 cubic yards of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.10.1.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.10.1.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.10.2 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb-forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.10.3 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.11 SURFACE DEFICIENCIES AND CORRECTIONS

3.11.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.11.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 1/4 inch. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.11.3 Appearance

The Owner will inspect exposed surfaces of the finished work and any deficiencies in appearance will be identified. The approved test section of colored concrete will be used as a standard for appearance required. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

END OF SECTION

# SECTION 321543 - STABILIZED COQUINA PATHWAY

## PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes material and labor requirements for construction of a coquina/aggregate pathway with Stabilizer binder additive for the following items:

1. Stabilized coquina sand/aggregate pathways

1.2 PERFORMANCE REQUIREMENTS

A. Perform gradation of a crushed coquina in accordance with ASTM C 136 – Method for Sieve Analysis for Fine and Coarse Aggregates.

1.3 SUBMITTALS

A. Products Data: For each product specified. Submit a 5 lb. sample and sieve analysis for grading of 1/8" minus coquina to be sent to Stabilizer Solutions, Inc. prior to any construction – (allow 2-week turn around). Must be approved by Landscape Architect and Town.

B. Maintenance Instructions: Submit copy(ies) of manufacturer's written maintenance instructions.

1.4 PROJECT/SITE CONDITIONS

A. Field Measurements: Verify field dimensions prior to proceeding with the work. Where surfacing is indicated to fit with other construction, verify dimensions of other construction by field measurements before proceeding with the work.

B. Environmental Limitations: Do not install Stabilized Aggregate pathway during rainy conditions or below 40 degrees Fahrenheit and falling.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer to provide evidence to indicate successful experience on a minimum of one (1) projects within the last two (2) years in installing Stabilized Coquina Sand Aggregate surfaces.

B. Mock-ups: Install 4' x 4' mock-up of crushed aggregate surfacing with Stabilizer additive at location specified by Town.

C. Compaction testing to be provided by contractor, one test per 2,000 square feet of base course.

D. Manufacturer's technical representative shall visit the site at the start of an installation to ensure the installer understands the correct installation methods to use.

1.6 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Town of other rights the Town may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty executed by the installer agreeing to repair or replace components of Stabilized Aggregate that fail in materials or workmanship within the specified warranty period. Stabilizer Solutions, Inc. does not warranty "Stabilizer®" purchased from a non-approved Stabilizer Solutions, Inc. licensee. Failures include, but are not limited to, the following:

1. Premature wear and tear, provided the material is maintained in accordance with manufacturer's written maintenance instructions.

2. Failure of system to meet performance requirements.

C. Warranty Period: Contractor shall provide warranty for performance of product. Contractor shall warranty installation of product for the time of one year from completion.

D. Contractor shall provide, for a period of sixty days, unconditional maintenance and repairs as required.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

A. Stabilizer for Stabilized Aggregate surfaces provided by the following manufacturer or approved equal:

1. Stabilizer Solutions, Inc. 33 South 28th St., Phoenix, AZ 85034.
Phone (602) 225-5900, (800) 336-2468; fax (602) 225-5902; website stabilizersolutions.com; email info@stabilizersolutions.com

2.2 MATERIALS

A. COQUINA SAND - 1/8”(-) crushed coquina/aggregate screenings

1. Sand and crushed stone shall consist of inert materials that are hard and durable, with stone free from surface coatings and deleterious materials. Gradation requirements shall be as follows:

2. Crushed Coquina Sand Sieve Analysis Percentage of Weight Passing a Square Mesh Sieve AASHTO T11-82 and T2782

1/4" MINUS AGGREGATE GRADATION

| U.S. Sieve No. | Percent Passing by Weight |
|---|---|
| # 3/8" | 100 |
| # 4 | 90 – 100 |
| # 8 | 75 – 80 |
| # 16 | 55 – 65 |
| # 30 | 40 – 50 |
| # 50 | 25 – 35 |
| # 100 | 15 – 20 |
| # 200 to | 10 – 15 |

3. Acceptable Coquina local supplier:

a) THE BUSHEL STOP
20700 Griffin Rd, Southwest Ranches, FL 33332
Phone: (954) 434-1729

b) or equal, approved by Landscape Architect.

B. Stabilizer Special Blend Binder

1. Patented, non-toxic, organic binder that is a colorless and odorless concentrated powder that binds decomposed granite or crushed 1/4" minus aggregate.
2. Product to have 64% pre-consumer recycled content.
3. Product shall have 25 years of experience at same formulation.

2.3 EXCESS MATERIALS

A. Provide Town with the following excess materials for use in future Stabilized Aggregate repair: 40 to 50 lb. Bags of the Stabilized Aggregate blended with proper amount of Stabilizer.

**PART 3 - EXECUTION**

3.1 PREPARATION

A. Base shall be minimum 3" crushed lime rock or as specified by Civil engineer. Make any corrections necessary to base furnished and installed to bring gravel to the elevations shown on the drawing.

B. Pre-soak base material with water and compact to 95% determined by Test Method ASTM D 1557 prior to installing Stabilized Aggregate. Compaction testing to be provided by Contractor, one test per 2,000 square feet of base.

C. Stabilized Aggregate is not meant to be used as a drainage facility. Although porous, it is recommended to have proper drainage available to ensure no standing water on surface or adjacent to Stabilized Aggregate, including downspouts when placed under roof overhang and surface drains.

3.2 BLENDING STABILIZER SPECIAL BLEND

A. Stabilizer Special Blend shall be thoroughly pre-mixed with coquina at the rate of 20-lbs of Stabilizer Special Blend per 1-ton of coquina with fines. Verify with manufacturer correct Stabilizer Special Blend rate for project and climate. Drop spreading of Stabilizer Special Blend over pre-placed coquina/aggregate or mixing by rototilling is not acceptable. Stabilizer Special Blend shall be mechanically pre-mixed per manufacturer's recommendations using an approved mechanical blending unit to adequately blend Stabilizer Special Blend with coquina/aggregate (Bucket blending is not an approved blending apparatus). Always blend Stabilizer Special Blend and coquina/aggregate DRY.

3.3 PLACEMENT

A. After pre-blending, place Stabilized coquina/aggregate directly on prepared sub-grade. Level to desired grade and cross section. Depth of pathways shall be 3" for heavy foot traffic and light vehicles. DO NOT place on filter fabric. Contact Stabilizer Solutions, Inc. for installation on slopes greater than 8%.

3.4 WATERING

A. Water heavily for full-depth moisture penetration of profile. Water activates Stabilizer. Apply 25 to 45-gallons of water per 1-ton to achieve saturation. Randomly test for depth using a probing device, which reaches full depth. Ensure moisture has reached full depth of profile.

B. Contractor shall wait a minimum of 6 – 72 hours or until such time that the Stabilized Aggregate is able to accept compaction from a 1 to 5 ton roller without separation, plowing or any other physical compromise of the aggregate.

C. If surface aggregate dries significantly quicker than subsurface material, lightly mist surface before compaction.

3.5 COMPACTION

A. Compact Stabilized Aggregate to 85% relative compaction by equipment such as; a 1 to 5-ton double drum roller making 3 to 4 passes. Do not begin compaction for 6 hours after placement and up to 72 hours. DO NOT use a vibratory plate compactor or vibration feature on roller, as vibration separates large aggregate particles. If pumping or pancaking of surface occurs, surface is still too wet to roll.

B. Take care in compacting surface when adjacent to planting and irrigation systems, use 8” or 10” hand tamp. Installation of Stabilized Aggregate more than 3” thick shall be installed in lifts to encourage moisture penetration. If 4” thick compacted (2) 2” lifts. If 5” thick compacted (2) 2.5” lifts. If Stabilized Aggregate is pre-moistened before installation entire 4” or 5” lift may be installed.

C. Lightly spray surface area following compaction. Do not disturb aggregate with spray action.

3.6 INSPECTION

A. Installation must be allowed time to fully dry. Finished surface shall be smooth, uniform and solid with no evidence of chipping or cracking. Cured and compacted pathway shall be firm throughout profile with no spongy areas. Loose material shall not be present on surface after installation, but may appear after use and according to environmental conditions. Pathway shall remain stable underneath loose granite on top with a “natural” look. Any significant irregularities in path surface shall be repaired to the uniformity of entire installation.

3.7 PROTECTION

A. Contractor shall furnish and install construction fence around new surface to prevent public access as required by Town. Fencing shall be maintained in place for a minimum of 12 - 72 hours after completion of installation, or as directed by the Town. Drying period may take longer due to weather conditions.

B. Contractor shall notify Town that landscape irrigation shall be restricted near Stabilized Aggregate surface until drying period is complete. Standing water on surface and adjacent to path shall be restricted at all times.

3.8 MAINTENANCE

A. Remove debris, such as paper, grass clippings, or organic material by mechanically blowing or hand raking as needed.

B. During first year, minor amounts of loose aggregate may appear on surface (1/16 to 1/4"). If material exceeds a ¼", redistribute over entire surface. Water to 1" depth and compact with power roller of no less than 1000-lbs. Repeat as needed. If cracking occurs, sweep fines into cracks, water thoroughly and hand tamp with an 8" – 10" hand tamp.

3.9 REPAIRS

A. Excavate damaged area to the depth of the Stabilized Aggregate and square off sidewalls.

B. If area is dry, moisten damaged portion lightly.

C. Pre-blend the dry required amount of Stabilizer Special Blend with the proper amount of coquina/aggregate in a concrete mixer.

D. Add water to the pre-blended Stabilized Aggregate. Thoroughly moisten mix with 25 to 45 gallons per 1-ton of pre-blended material or to approximately 10% moisture content.

E. Apply moistened pre-blended Stabilized Aggregate to excavated area to finish grade.

F. Compact with an 8" to 10" hand tamp or 250 to 300 pound roller. Keep traffic off areas for 12 to 48 hours after repair has been completed.

**END OF SECTION**

## SECTION 321816.13 – POURED IN PLACE SAFETY SURFACING

### PART 1 - GENERAL

#### 1.1 SCOPE

A. The work in this section shall include but not be limited to the following:
   1. Poured-in-place (non-loose fill) playground surfacing system.
   2. Related Sections: Excavation, concrete paving.

#### 1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
   2. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
   3. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
   4. ASTM D2859 Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
   5. ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester Equipment.
   6. ASTM F1292 Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment.
   7. ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

#### 1.3 PRODUCT REQUIREMENTS

A. Performance Requirements: Provide a 2-layer rubber-polyurethane playground surfacing system which has been designed, manufactured and installed to meet the following criteria:
   1. Shock Attenuation (ASTM F1292):
      A. Gmax: Less than 200.
      B. Head Injury Criteria: Less than 1000.
   2. Flammability (ASTM D2859): Pass.
   3. Tensile Strength (ASTM D412): 60 psi (413 kPa).
   4. Tear Resistance (ASTM D624): 140%
   5. Water Permeability: 0.4 gal/yd2/second.
   6. Accessibility: Comply with requirements of ASTM F1951 and Americans with Disabilities Act.

1.4 **SUBMITTALS**

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product data and installation instructions.

C. Verification Samples: Submit for each product indicated and for each color and texture required.

D. Shop Drawings: Show materials, cross sections, and drainage.
1. Show penetration details
2. Show edge terminations

E. Quality Assurance/Control Submittals: Submit the following:
1. Certificate of qualifications of the playground surfacing installer.
2. Product test reports
3. Maintenance data

F. Closeout Submittals: Submit the following:
1. Warranty documents specified herein.

1.5 **QUALITY ASSURANCE**

A. Qualifications: Utilize an installer approved and trained by the manufacturer of the playground surfacing system, having experience with other projects of the scope and scale of the work described in this section.
B. Certifications: Certification by manufacturer that installer is an approved applicator of the playground surfacing system.
C. International Play Equipment Manufacturers Association (IPEMA) certified.
D. Standards and Guidelines: Provide playground surface systems complying with applicable provisions of the following, unless more stringent provisions are indicated:
1. CPSC No. 325, "Handbook for Public Playground Safety"; ASTM F 1292 and ASTM F 1487.

1.6 **DELIVERY, STORAGE AND HANDLING**

A. General: Comply with Division 1 Product Requirement Section.

B. Delivery: Deliver materials in manufacturer's original unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F and a maximum temperature of 90 degrees F.

1.7 **PROJECT / SITE CONDITIONS**

A. Environmental Requirements: Install surfacing system when minimum ambient temperature is 33 degrees F and maximum ambient temperature is 90 degrees F. Do not install in steady or heavy rain

1.8 **WARRANTY**

A. Project Warranty: Refer to conditions of the contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights owner may have under contract documents.
   1. Warranty Period: 5 years from date of completion of work

**PART 2 - PRODUCTS**

2.1 **POURED-IN-PLACE PLAYGROUND SURFACING SYSTEM**

A. Manufacturer: Hanover Specialties, Inc. Product-Vitriturf (or approved equal)
B. Proprietary Products/Systems. Poured-in-place playground surfacing system, including the following:
   1. Vitriturf Primer
      A. Material: Polyurethane
   2. Vitriturf Basemat
      A. Material: Blend of 100% recycled SBR (styrene butadiene rubber) and polyurethane.
      B. Thickness: The type of playground equipment determines the required basemat thickness, and the basemat thickness may be different at various locations on the playground site. Refer to ASTM F 1292 requirements for critical height and recommended basemat thickness and coordinate with plan drawings play equipment manufacturer's recommendations. Thickness 1" (25.4 mm), 1-1/2" (38 mm), 2" (51 mm), 2-1/2" (64 mm), 3-1/2" (89 mm), 4" (102 mm).
      C. Formulation Components: Blend of strand and granular material.

   3. Vitriturf Wearing Course:
      A. Material: Blend of recycled EPDM (ethylene propylene diene monomer) and polyurethane.
      B. Thickness Nominal ½" (12.7 mm), minimum 3/8" (9.5 mm), maximum 5/8" (15.9 mm).
      C. As specified on the construction drawings
      D. Dry Static Coefficient of Friction (ASTM D2047): 1.0
      E. Wet Static: Coefficient of Friction (ASTM D2047): 0.9
      F. Dry Skid Resistance (ASTM E303): 89
      G. Wet Skid Resistance (ASTM E303): 5.7

2.2 **PRODUCT SUBSTITUTIONS**

A. Substitutions: No substitutions permitted.

2.3 **MIXES**

A. Required mix proportions by weight:
   1. Basemat: 18% polyurethane, 82% rubber.
   2. Top Surface: 20% polyurethane, 80% rubber.

**PART 3 - EXECUTION**

3.1 **MANUFACTURER'S INSTRUCTIONS**

A. Comply with the instructions and recommendations of the playground surfacing manufacturer.

3.2 **EXAMINATION**

A. Site Verification of Conditions: Verify that substrate conditions are suitable for installation of the playground surfacing system.
B. Do not proceed with installation until unsuitable conditions are corrected.

**3.3 PREPARATION**

A. Prepare subsurface in accordance with manufacturer's instructions to ensure proper support drainage for poured-in-place safety surfacing.
B. Compacted, granular aggregate subsurface shall be as indicated in the drawings and per the manufacturer's recommendations.
C. Variations in Elevations. Repair variations in elevation of compacted subsurface greater than plus or minus ¼ inch over 10 feet in any direction.

**3.4 INSTALLATION**

A. Install playground safety surfacing system in accordance with manufacturer's instructions as indicated at locations indicated ion the drawings.
B. Do not proceed with playground surfacing installation until unsatisfactory conditions of the substrate have been corrected and all applicable site work, including fencing, playground equipment installation and other relevant work, has been completed.
C. Prepare substrate to receive surfacing products according to playground surface system manufacturer's written instructions. Verify that substrates are sound without high spots, ridges, holes, and depressions.
   1. Use trowelable leveling and patching materials, according to manufacturer's written instructions, to fill holes and depressions.

2. Mechanically Scarify or otherwise prepare concrete substrates according to manufacturer's written instructions to achieve recommended degree of roughness.
3. Saw cut concrete for terminal edges of seamless playground surface systems.

D. Basemat Installation: Provide uniform, monolithic wearing surface and impact-attenuating system of a total thickness indicated. Prevent contamination during application and curing processes.
1. Using screeds and hand trowels, install the basemat at a consistent density of 29 pounds, 10 ounces per cubic foot to the specified thickness.
2. Basemat to be applied in one continuous operation, with a minimum of cold joints.
3. Allow basemat to cure for sufficient time so that indentations are not left in the basemat from applicator foot traffic or equipment.
4. Do not allow foot traffic or use of the basemat surface until it is sufficiently cured

E. Primer Application: Using a brush or short nap roller, apply primer to the basemat and any adjacent vertical barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 ft2/gal. – apply primer for maximum adherence to basemat.

F. To Surface Installation:
1. Using a hand trowel, install top surface at a consistent density of 58 pounds, 9 ounces per cubic foot to form a level layer of uniform density and consistency, applied in one continuous operation, and, except where color changes with a minimum of cold joints. Finish surface to produce manufacturer's standard wearing-surface texture.
A. Where color pattern is indicated, place adjacent colored material as soon as placed colored material is sufficiently cured using primer or adhesive if required by manufacturer's written instructions.
1. Edge Treatment: As indicated on the drawings and details. Fully adhere edges to substrate with full coverage of substrate. Maintain fully cushioned thickness.
2. Provide protection to prevent traffic over system for not less than 48 hours after installation.
3. At the end of the minimum curing period, verify that the top surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.
4. Cleaning: During installation of adhesively applied products, immediately remove visible adhesive from surfaces. Use cleaner recommended by playground surface system manufacturer.

**3.5 PROTECTION**

A. Protect the installed playground surface from damage resulting from subsequent construction activity on the site.

B. Poured-in-Place Surfacing: Do not allow foot traffic on poured-in-place rubber surfacing until a minimum of 80 percent cure is obtained (6-48 hours depending on temperature and humidity).

**END OF SECTION**

# SECTION 323300 – SITE FURNISHINGS

## 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. Benches and Chairs.
   2. Bicycle racks.
   3. Trash & recycling receptacles.
   4. Tables.

B. Related Sections include the following:
   1. Division 03 Section "Cast-in-Place Concrete" for installation of anchor bolts and formed voids in concrete footings.
   2. Division 31 Section "Earth Moving" for excavation for installation of concrete footings.

C. Products furnished, but not installed under this Section, include pipe sleeves, and anchor bolts to be cast in concrete footings.

### 1.3 SUBMITTALS

A. Comply with Division One. All submittals shall be accepted by the Landscape Architect in writing before ordering products.

B. Product Data: For each type of product indicated.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
   1. Size: Not less than 6-inch- (152-mm-) long linear components and 4-inch- (102-mm-) square sheet components.
   2. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

D. Material Certificates: For site furnishings, signed by manufacturers. Submit manufacturer's printed descriptions, instructions, test data and color samples for each product
   1. Wood Preservative Treatment: Include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
   2. Sustainably Harvested Wood: Include certification by manufacturer and from sources that participate in sustained yield programs.
   3. Recycled plastic.

E. Maintenance Data: For site furnishings to include in maintenance manuals. Submit manufacturer's recommended cleaning and stain removal methods and cleaning materials.

F. Warranty documentation: Submit warranty documentation in accordance with this Section.

G. Substitutions: Prior to start of any work in this Section contractor shall submit all pertinent data to allow for complete review of all substitutions of product. Once work has started in this Section, no substitutions without prior approval by the Landscape Architect will be allowed.
   1. Submit shop drawings for substitutions that differ in materials from the Drawings. Include details of setting methods, material, location, and accessories for all non-specified products.

## 1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Bench Replacement Planks: No fewer than two full-size units for each size indicated.
   2. Trash Receptacle Inner Containers: 4 full-size units for each size indicated.
   3. Anchors: 2 anchor units per details shown on drawings

## 1.5 PROJECT/SITE CONDITIONS

A. Environmental requirements:
   1. Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.

B. Existing conditions:
   1. Existing Plants: Do not damage any existing plantings indicated to remain.
   2. Utilities: Determine location of underground utilities. Perform work in a manner to avoid possible damage. Hand excavate, as required.
   3. Excavation: Maintain grade stakes set by others until parties concerned mutually agree upon removal. When conditions detrimental to Work are encountered, such as rubble fill, adverse drainage conditions, noxious materials or obstructions, notify Landscape Architect before proceeding.

## 1.6 SEQUENCING AND SCHEDULING

A. Work scheduling: Proceed with and complete Work as rapidly as portions of the site become available, working within the specified environmental requirements.

## 1.7 WARRANTY AND REPLACEMENT

A. General: Refer to Division One.

B. Site furnishings warranty conditions: Warranty all site furnishings against defects due to any cause. The following warranty conditions apply:
   1. The contractor, by commencing the work of this Section, assumes overall responsibility, as part of his warranty of the work, to assure that all assemblies, components, and parts shown or required within the Work of this Section comply with contract documents. The contractor shall further warrant:
      a. That all components, specified or required to satisfactorily complete the installation, are compatible with each other and with the conditions of installation and expected use.

b. The overall effective integration and correctness of individual parts and the whole of the system.
c. Compatibility with adjoining existing substrates, materials and work by other trades.
d. There shall be no material failure due to improper design or installation of site furnishings. All materials are to fully perform to their normal life expectancy.

2. If site furnishings fail after having been replaced previously, item shall be replaced until it is approved. The warranty period begins anew and extends each time an item requires replacing. Replacement site furnishings shall be of the same kind, condition and quality as original and subject to all requirements in this specification.
3. All expenses incurred in the replacements shall be borne by the Contractor.
4. Make replacements within seven days of notification by Landscape Architect.

C. Warranty: Furnish manufacturer's warranty co-signed by Contractor which includes all labor and materials to replace all items which have failed within a minimum period of three (3) years from date of final acceptance. Make final repairs/replacements before the expiration of the warranty period as directed by the Town and/or Landscape Architect.

**PART 2 - PRODUCTS**

2.1 BENCHES & CHAIRS: Benches shall be as shown on the Drawings and Furniture Schedule.

A. EMAU SOLO (EMS456N) Bench with back, or approved equal

B. RIVAGE (RVA251N) Chaise chair, or approved equal

C. STACK (STC212) Stool, or approved equal

D. VERA SOLO (LVS211N) Bench backless, or approved equal

E. EMAU (EM251N) Bench with back, or approved equal

F. STACK (STC257) Chair, or approved equal

G. STACK (STC255) Bench with back, or approved equal

H. VERA SOLO (LVS510N) Bench backless, 90 Degree, or approved equal

I. VERA SOLO (LVS22 / LVS50 / LVS51 / LVS52) Bench backless, 45 Degree, or approved equal

For all listed above:

1. Material: Per furniture schedule on drawings.

2. Installation Method: Surface mounted or movable as indicated by manufacturer instructions & furniture schedule.

3. Available Fabricator: mmcité usa LLC
Sheryl Sinclair
architectural products + site furnishings
a division of Power & Lighting Systems, Inc
Office: 786-574-8109
ssinclair@p-ls.com
https://www.mmcite.com/en

2.2 BICYCLE RACKS

A. Bicycle Rack: EDGETYRE (STE210N) or approved equal
1. Installation Method:
a. Embedded Installation.
b. As indicated by manufacturer instructions

2. Material: Per furniture schedule on drawings.

3. Available Fabricator: mmcité usa LLC
Sheryl Sinclair
architectural products + site furnishings
a division of Power & Lighting Systems, Inc
Office: 786-574-8109
ssinclair@p-ls.com
https://www.mmcite.com/en

2.3 TRASH & RECYCLING RECEPTACLES

A. CRYSTAL (CS331X) or approved equal
1. Installation Method: Surface Mounting, as indicated by manufacturer instructions

2. Material: Per furniture schedule on drawings.

3. Available Fabricator: mmcité usa LLC
Sheryl Sinclair
architectural products + site furnishings
a division of Power & Lighting Systems, Inc
Office: 786-574-8109
ssinclair@p-ls.com
https://www.mmcite.com/en

2.4 TABLES: Tables shall be as shown on the Drawings.

A. TABLY (TBL421) Table or approved equal
1. Material: Per furniture schedule on drawings.

2. Installation Method: As indicated by manufacturer instructions

3. Available Fabricator: mmcité usa LLC
Sheryl Sinclair
architectural products + site furnishings
a division of Power & Lighting Systems, Inc
Office: 786-574-8109
ssinclair@p-ls.com
https://www.mmcite.com/en

B. STACK (STC410) Table or approved equal
1. Material: Per furniture schedule on drawings.

2. Installation Method: As indicated by manufacturer instructions

3. Available Fabricator: mmcité usa LLC
Sheryl Sinclair
architectural products + site furnishings
a division of Power & Lighting Systems, Inc
Office: 786-574-8109
ssinclair@p-ls.com
https://www.mmcite.com/en

2.5 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

F. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

G. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ANCHORS, FASTENERS, FITTINGS and HARDWARE

A. Manufacturer’s standard corrosive-resistant-coated, non-corrodible, materials. Commercial quality, tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged. Provide as required for site and street furnishing’s assembly, mounting and secure attachment.
1. Angle Anchors: For inconspicuously bolting legs of site and street furnishings to on-grade substrate; per manufacturer’s recommendations.

2.7 STAINLESS-STEEL FINISHES (if applicable)

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and media-blast surfaces to produce uniform, textured, finish indicated on drawings, free of cross scratches. Run grain with long dimension of each piece.

**PART 3 -** EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch (19 mm) larger than OD 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, with top smoothed and shaped to shed water.

F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

3.3 FIELD QUALITY CONTROL

A. Inspections:
General: All site furnishings are subject to the Landscape Architect's approval prior to, during and after installation. Replace rejected site furnishings with satisfactory items.

B. Landscape Architect’s or Town inspection of the dimensional site furnishings does not release the Contractor from his responsibility to provide all the work in accordance with the specifications and Drawings.

3.4 CLEANING

A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

B. Remove protective covering.

C. Repair defective Work.

D. After completion of repair work, clean exposed surfaces with clean water. Use cleaner and procedures recommended by manufacturer and fabricator. Do not use wire brushes, metal scrapers or acids. Protect adjacent surfaces from damage during cleaning operations.

E. Prepare small sample areas in presence of Landscape Architect for acceptance of procedures.

F. Repair: After cleaning, examine work and repair unacceptable conditions. Replace defective, broken, permanently stained, or damaged units. Repair unfilled or defective joints.

**END OF SECTION**

# 329019 – LANDSCAPE MAINTENANCE

## PART - 1 GENERAL

### 1.1 SUMMARY

A. Surfside 96th Street Park is a public space owned and operated by the Town of Surfside, hereinafter referred to as "Town". Any and all contractors associated with this project are hereinafter referred to as "Contractor".

B. The landscape design objectives are to provide a variety of visually pleasing, accessible outdoor spaces for the public that reflect South Florida's native ecology and provide the foundation for a diversity of uses and experiences. Approximately twenty acres of park include spaces for formal and informal gatherings, exploration and discovery, peaceful relaxation and the excitement of active recreation. The emphasis is on native and drought tolerant species to reduce maintenance.

C. The Maintenance scope-of-work is summarized in the table below:

| Maintenance Task | Frequency |
|---|---|
| **Trash Pick-Up** | Daily |
| **Hardscape Cleaning** | Weekly |
| **Irrigation System Checks and Repairs** | Monthly |
| **Mowing** | Min. 38 cuts per year |
| **Edging and Trimming** | Monthly |
| **Shrub Pruning** | Monthly |
| **Mulching** | Quarterly |
| **Weeding** | Twice Monthly |
| **Tree Pruning, Hardwoods** | 1 time every 2 to 3 years |
| **Tree Pruning, Palms** | 3 times per year |
| **Fertilization** | 3 times per year |
| **Pest Scouting and Treatment** | Quarterly |

1.2 QUALITY ASSURANCE

A. Contractor shall be an individual or firm of established reputation, with documented experience in at least three (3) large-scale public-sector landscape projects, which is regular force to workers skilled in performing work as outlined in this document.

B. All Contractors shall be insured with Workers' Compensation Insurance as required by the State of Florida, General Liability Insurance with a minimum limit of $1,000,000 combined single limit per occurrence and proof of Comprehensive Automobile Liability Insurance.

C. All Contractors shall have any and all current licensing as required to perform the specified services in the Town of Surfside, Florida.

1.3 CONTRACTOR RESPONSIBILITIES

A. All Contractors shall comply with all sections of these specifications.

B. All Contractors shall visit the site and inspect the landscape prior to submitting a bid.

C. No Landscape Sub-contractor shall assign or further sub-contract work without the prior written consent of the Town.

D. All Contractors shall designate a full-time competent supervisor or foreman to oversee all activities described in these specifications. All Contractors shall comply with all applicable local, state and federal health and safety requirements, including but not limited to, the latest revisions of Occupational Safety and Health Administration (OSHA) standards, American National Standards Institute (ANSI) Z133.1-2000 (Tree Care Operations-Safety Requirements) and State of Florida Department of Transportation (FDOT vehicles safety and traffic control requirements).

E. All Contractors shall be responsible for providing all labor and materials needed to completely and accurately perform the work outlined in these specifications. Equipment and materials furnished shall be of the appropriate type, size, and quantity needed to adequately accomplish the specified work. Machetes, breakage by hand, and climbing spikes shall not be permitted.

F. All Contractors shall be responsible for regularly inspecting all equipment to be used on the job site and for providing scheduled preventative maintenance, so as to prevent any damage or injury to landscaping, structures, or the environment.

G. All Contractors shall be responsible for notifying the Town and for the cost and repair of any damage to irrigation systems, buildings, vehicles or other structures, properties or possessions,

which occur as a result of improper or negligent activities within the respective realm of responsibility, as defined in these specifications.

H. Contractors shall not be responsible for damages caused by others, vandalism, or Acts of Nature.

## PART - 2 SCOPE-OF-WORK

### 2.1 PLANT MAINTENANCE IN WARRANTY PERIOD

**A. The selected landscape contractor shall be responsible for maintaining ALL plant material throughout the warranty period as specified in the Planting specifications.**

### 2.2 SITE INSPECTIONS

A. Contractor shall provide regularly scheduled site inspections at the frequency specified in each section herein. During each inspection Contractor shall note any needs for trash pick-up, hardscape cleaning, irrigation checks/repairs, landscape maintenance needs (i.e. pruning, weeding, mulching, etc.), tree or palm care, remedial fertilization, pest control needs, or other relevant landscape issues. Contractor shall immediately report to the Town any health or safety issues noted.

### 2.3 TRASH PICK-UP AND HARDSCAPE CLEANING

A. All areas of the property shall be inspected daily for trash and litter, which shall be picked up and disposed of each day.

B. All areas of the property shall be inspected for hardscape cleaning needs as outlined in Maintenance Tasks. All cleaning needs shall be addressed accordingly.

### 2.4 IRRIGATION SYSTEM MAINTENANCE

A. Contractor shall guarantee the entire irrigation system to be complete and fully functional in every detail for the period of one full year from the date of acceptance, per Irrigation Specifications.

B. Contractor shall be responsible for the maintenance, repairs, and timing of the irrigation system. The system shall be regularly inspected, at the frequencies outlined in the Maintenance tasks, to check for broken heads, lines, valves, timers, and water coverage patterns.

C. Broken heads and lines, and water coverage adjustments shall be made within 24 hours by the Contractor. Malfunctioning valves, pumps, or timers shall be reported to the Town for repair by a licensed irrigation contractor.

D. Irrigation timers shall be set according to the specific needs of each area or zone, and may be altered as per plant, site, and weather conditions. All current irrigation restrictions regulated by the South Florida Water Management District or other entities shall be enforced.

## 2.5 LANDSCAPE MAINTENANCE

A. Landscape maintenance shall consist of mowing, edging, and trimming of all turfgrass areas; pruning and trimming of all hedges, shrubs and ground covers; weed control in all landscape and hardscape areas; clearance pruning of trees and palms less than 15 feet in overall height; and mulch applications as specified herein.

## 2.6 MOWING

A. All grass turf areas shall be mowed with rotary mowers 1 time each 7 days from May 1 through October 31 and 1 time each 14 days between November 1 and April 30, or as needed to keep the grass from growing more than 1” above the cutting height. Total number of cuts per year shall be at least 38. Edging is to be completed with every lawn service.

B. Mowing height shall be 3” to 4”, as measured on a flat, paved surface. Mowing height in shaded areas shall be slightly higher.

C. All debris and/or litter shall be removed from turf areas prior to mowing.

D. Injuries to tree trunks, exposed roots, and shrub bases shall be avoided by either mowing at a greater height or by mowing around them and hand-trimming later.

E. Mower blades shall be kept sharp at all times so as to prevent tearing of leaf blades.

F. All grass clippings not collected or mulched by mowers shall be removed from parking lots, driveways, sidewalks, and planter beds using blowers, vacuums, brooms and/or rakes, Clippings shall not be blown out into streets or adjacent areas.

## 2.7 SHRUB PRUNING

A. All landscaped areas shall be inspected at least one time per week to ascertain whether any pruning and trimming is needed to maintain plants within their intended bounds, to remove dead or damaged plant parts including limbs, branches, palm fronds, stems, fruits, or flowers, and to keep plants from encroaching upon parking lots, driveways, sidewalks, streets, windows, signs, lighting, etc.

B. All hedges shall be sheared using gas-powered shearing equipment to maintain the desired height of 3 feet, rounded at the edges. Hedges shall be allowed to produce new foliage and flowers in between shearing operations. The bottoms of the hedges shall be maintained slightly wider than the tops to allow for adequate sunlight penetration.

C. All massed shrub beds shall be pruned as needed to maintain plants within their intended bounds, prune off old flowers, clean out old leaves, and create a naturalistic mass effect. Plants shall not be individually shaped. Maximum bloom shall be maintained by minimizing pruning.

D. All ground cover material shall be regularly pruned and cleaned as needed using the most appropriate tools for the job to remove any dead or damaged plant parts, including old leaves, flowers, and stems. Periodically, it may be necessary to thin or reduce the size of the plantings by removing sections of plants or clusters.

E. All ornamental/native grasses shall be cut back to their bases a minimum of one (1) time per year immediately following the completion of the bloom cycle. Additional pruning shall be performed if needed due to exceptionally dry or windy weather.

F. All palms which are less than 15 feet in overall height shall be pruned as needed to remove brown fronds, coconuts, and inflorescences. Each individual frond shall be cut as close to the trunk as possible, removing the entire leaf base, including all spines. Thatch accumulations on trunks shall be regularly removed as it naturally loosens. Any palms which have spines on their leaf stems and are located within 3 feet of a pedestrian area shall regularly have the spines hand-clipped from the bases of the fronds, or the entire frond shall be removed if it does not create an unbalanced crown.

G. All clustering palms which are less than 15 feet in overall height shall be pruned as needed to remove brown fronds and inflorescences. Periodically (no more than one time per year), some thinning of the clusters may be required; approximately 1/4 to 1/3 of the total number of stems, evenly distributed throughout the cluster and at staggered heights, shall be cut at ground level and removed. Palms shall not be “cleaned” such that all young stems are removed.

H. All hardwood trees which are less than 15 feet in overall height shall be pruned as needed to remove dead branches, or to raise or reduce crowns to prevent them from encroaching into

pedestrian/vehicular areas, over windows, sidewalks, signs, etc. There shall be no other "cleaning", "thinning", or "raising" of tree crowns. All other tree and palm pruning shall be the responsibility of a qualified arborist or tree crew.

I. All clippings and debris, including fallen palm fronds and nuts, shall be collected a minimum of three (3) days a week and disposed of at authorized dumping or recycling sites as approved by the Town.

## 2.8 MULCHING

A. All hedges, shrubs, planter beds, and free-standing palms and hardwood trees shall be mulched at a depth of two (2) to three (3) inches at all times per the planting details in the Landscape Plans.

B. Mulch shall be Grade B or better, processed entirely from the Melaleuca tree and composed of 97% hard inner wood and 3% outer bark. It shall be naturally colored, uniformly shredded and free from foreign matter, large pieces of bark, tree stump material, burrowing nematodes and ants. (Melaleuca mulch must have a written guarantee that there will be no germination of Melaleuca seed present in the mulch. If germination occurs, the Contractor shall be responsible for removal of the mulch and seedlings to the satisfaction of the Landscape Architect. The mulch shall be replaced with another acceptable mulch approved by the Landscape Architect).

## 2.9 WEED CONTROL

A. Weeds shall be removed by hand on an on-going basis throughout the year in all landscaped areas, including the removal of weeds growing in thatch on palm trunks, fallen palm fruits, and tree/palm seedlings ("volunteers") in hedges and shrub beds.

## 2.10 TREE AND PALM CARE

A. All shade trees and palms shall be pruned following the standards set forth in the most recent edition of American National Standard for Tree Care Operations, ANSI A-300 (Part 1)- Pruning; (11 West 42 Street, New York, N.Y. 10036).

B. Pruning practices including tree inspection, tools and equipment, and pruning cuts, shall be performed as outlined in the ANSI A-300 standards.

C. Hardwood trees and palms shall be pruned on a regular cycle, which shall be determined according to pruning objectives, tree species, tree age/size, tree condition, location, and usage.

D. Hardwood trees shall be pruned on a regular cycle as specified in the Schedule I and Schedule II tasks.

E. Trees with crowns which spread over roadways shall be pruned by canopy raising and/or canopy reduction such that a 15-foot vertical clearance is maintained.

F. Trees with crowns which spread over sidewalks and other pedestrian areas shall be pruned by canopy raising and/or canopy reduction such that an 8-foot vertical clearance is maintained.

G. Trees with crowns which spread over parking lots shall be pruned by canopy raising and/or canopy reduction such that a 12-foot vertical clearance is maintained.

H. Trees adjacent to buildings, structures, power lines, fences, light posts, signs, or other fixtures shall have their crowns reduced to provide clearance from those structures or fixtures.

I. Palms in Schedule I areas shall be pruned 3 times per year, once in the early spring (March-April), once in the early summer (June-July), and once in the fall (September-October). Palms in Schedule II areas shall be pruned 2 times per year in the late spring/early summer (May-June) and late fall (September-October).

J. Palms shall be pruned such that all brown lower fronds and no more than 1 to 2 rows of live fronds are removed. Live healthy fronds above horizontal shall not be removed (maximum frond removal shall result in what is commonly referred to as a “9 and 3” position, as it relates to the face of a clock). All inflorescences and fruits (including coconuts) shall be removed.

K. Palm frond petioles shall be severed as close to the trunk as possible without causing damage to trunk tissues. All loose frond bases (“boots” and “thatch”) shall be removed. Those which do not readily abscise shall not be forced, torn, or shaven. All weeds (including volunteer tree seedlings) shall be removed from the remaining “boots” or “thatch” by cutting or pulling.

L. After pruning the royal palms, the green leaf sheaths shall be bound to the crown shafts using plastic tie wraps to prevent them from falling. During each pruning operation, the tie wraps shall be removed, and the loose sheaths removed, then new tie wraps shall be installed.

## 2.11 FERTILIZATION

A. All fertilizers shall be applied in a professional, workmanlike manner in accordance with all state and local laws pertaining to the handling and usage of hazardous materials.

B. Fertilizers shall be provided on a regularly scheduled basis using the fertilizer types, rates, and frequencies specified herein. Monthly site inspections shall include evaluations of plant health and any subsequent needs for remedial fertilization.

## 2.12 FERTILIZER TYPES

A. The fertilizer to be used on all landscape material except for turfgrass, and ferns, orchids, annuals, or other species sensitive to granular fertilizers, shall be in granular form and have a 4-1-6 or similar ratio of N, P, and K (i.e., “Palm Special” 8-2-12), with at least 50% of the nitrogen, potassium, and magnesium in the slow-release forms, preferably sulfur-coated. Fertilizer mix shall also contain micronutrients, specifically manganese (at least 1%), iron (at least 1%), and trace amounts (less than 1%) of born, copper, and zinc.

B. **Turfgrass fertilizer shall be approved by the Town prior to use**. “Weed-and-Feed” products shall not be used unless approved by Town and targeted for specific weed infestations and must be labeled for Bermuda grass.

C. Fertilizer for ferns, orchids, annuals, or other species sensitive to granular fertilizer shall be a slow-release resin-coated product containing an N, P, and K ratio of 1-1-1 (i.e., Osmocote or Nutricote). Soluble fertilizers with a 1-1-1 ratio (i.e., Peter’s) shall be used as needed to supplement the above.

D. A micronutrient product which contains sulfur, manganese sulfate, chelated iron, zinc, boron, and molybdenum shall be used on all specimen palms and any other species susceptible to deficiencies of such. It shall also be used as a supplement when needed to correct deficiencies.

## 2.13 FERTILIZER FREQUENCY

A. All landscaped areas excluding ferns, orchids, annuals, or other species sensitive to granular fertilizers shall be fertilized 3 times per year in February, June, and October.

B. Trees and palms with reduced rooting space in small planters or beds, or those with extensive ground cover beneath, shall have overall fertilizer rates proportionately reduced by 1/3 to 1/2 and frequencies increased to 6 times per year (1 time each 2 months) to prevent phytotoxicity.

C. Ferns, orchids, annuals and other sensitive species shall be fertilized with resin-coated materials one time each 3 to 4 months, or as specified on the label. Soluble products shall be used as often as 1 time per month if needed to supplement the above.

D. Micronutrient products shall be provided 4 times per year on specimen palms and other plants susceptible to deficiencies. It shall also be used as needed to supplement and correct deficiencies.

## 2.14 FERTILIZER RATES

A. Turfgrass, hedges, shrubs, and ground covers shall be fertilized at the rate of 1.0 lb. of actual potassium per 1,000 square feet of area.

B. All free-standing palms and hardwood trees shall receive 1 to 8 pounds of the product recommended above, as per individual tree size (1 to 3 pounds each for small trees/palms; 3 to 5 pounds for each of the mid-size trees/palms; 5 to 8 pounds for large trees/palms).

C. Trees and palms with reduced rooting space in small planters or beds, or those with extensive ground cover beneath, shall have overall fertilizer rates proportionately reduced by 1/3 to 1/2 and frequencies increased to 6 times per year (1 time each 2 months) to prevent phytotoxicity.

D. Resin-coated fertilizer shall be applied at label rates as specified for the intended plant species.

E. Micronutrient products shall be mixed at label rates.

## 2.15 APPLICATION METHODS

A. Fertilizer for all plant material except turfgrass shall be broadcast by hand underneath plant canopies prior to mulch applications. Fertilizer application shall begin at 2 to 6 inches away from trunks/crowns of trees and shrubs and continue out to the dripline of the plants. Granular fertilizer shall not be allowed to accumulate on any plant leaves, in plant crowns, or at leaf bases.

B. Fertilizers shall not be applied to any drought-stressed plants or wet foliage.

C. Turfgrass fertilizer shall be applied with a rotary spreader after dew and irrigation water has dried from the leaves.

D. Fertilizer for ferns, orchids, annuals or other species sensitive to granular fertilizer shall be broadcast by hand on the soil surface beneath the plants.

E. Micronutrient products shall be mixed with water at label rates and root-drenched around palms, sprayed and/or root-drenched on shrubs and ground covers.

F. Some overlap in fertilizer application can be expected in those areas which contain combinations of turf, shrubs, trees, and palms. Contractor shall be responsible for exercising judgment in reducing absolute rates of application where significant overlap occurs.

G. Spillage, runoff, and spray drift of fertilizers into parking lots, driveways, sidewalks, etc., shall be avoided and excess fertilizer shall be swept, blown, vacuumed, or hosed off of all hard surfaces immediately after application, so as to avoid staining.

H. Irrigation shall be set to run through one complete cycle immediately after granular fertilizer application.

## 2.16 PEST/DISEASE CONTROL

A. Pest control shall be implemented on an as-needed basis only as part of an Integrated Pest Management (IPM) program. Contractor shall inspect all areas of the landscape at least 1 time per month for early detection of actual or potential pest and/or disease infestations which may require treatment.

B. All other IPM methods shall be exhausted before chemical applications are considered for turf, trees, palms, and shrubs. Any pest or disease control measures must be approved in writing by Town staff.

C. If Town approved chemical treatment is required, Contractor shall use the most appropriate selective pesticide following all pesticide label directions, in a professional, workmanlike manner in accordance with all state and local laws pertaining to the handling and usage of hazardous materials

## 2.17 CLEAN-UP AND DISPOSAL

A. All debris shall be collected daily and disposed of at authorized dumping or recycling sites.

B. No tools or equipment shall be left on the site overnight except in authorized storage areas.

**END OF SECTION**

# SECTION 329300 - PLANTING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. The work included in this section consists of furnishing all labor, supplies equipment and materials necessary to complete the installation of all landscaping as shown on the Plans, including the installation of sod as shown, as well as all other related responsibilities as specified herein.

B. All plant materials included shall be of the specific size and quality indicated on the plans and in these specifications and shall be installed in strict accordance with sound nursery practices, and shall include plant delivery and temporary storage, mulching, fertilizing, maintenance, and watering for all work outlined on the plans and specifications until final acceptance.

C. The LANDSCAPE ARCHITECT, as approved by the Town, reserves the right to adjust the number and locations of the designated types and species to be used at any of the locations shown in order to provide for any modifications which might become necessary.

D. Investigation of Subsurface Conditions: The Contractor shall be responsible for making site subsurface investigations and examinations as he or she chooses in order to become familiar with the character of the existing material and the construction conditions under which he or she will be working. A soil analysis shall be conducted per the requirements set forth in Section 1.5 Testing. These subsurface investigations and examinations shall be included in the bid. Contractor shall not receive separate, additional compensation for such investigation.

E. Excavation Related to Findings of Subsurface Conditions: Some or all work areas may contain existing materials, such as but not limited to limerock, limestone, etc., and may be overly compacted. This material and any compacted material may interfere with adequate vertical drainage and/or proper plant survival and growth. Removal of this material, in order to have adequate vertical drainage, is part of the scope of work for the project. Compensation for any excavation and removal required, above and beyond the minimum requirements indicated, including any additional planting soil needed to fill the larger excavated area, shall be included in the bid. The Contractor shall not receive separate, additional compensation for this.

F. No separate, additional compensation will be granted because of any unusual difficulties which may be encountered in the execution of any portion of the work.

G. The Plans are not complete unless accompanied by these Specifications.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

A. Site Clearing

B. Site Grading

C. Earth Moving

D. Irrigation

E. Concrete Work

F. Landscape Maintenance

**1.3 QUALITY ASSURANCE**

A. The CONTRACTOR'S Superintendent shall be well versed in Florida plant material, planting operations, blueprint reading, and coordination with other performing contracts or services in the job area. All CONTRACTOR employees shall be competent and highly skilled in their particular job in order to properly perform the work assigned to them. The CONTRACTOR shall be responsible for maintaining the quality of the material on the job throughout the duration of its responsibility.

B. Acceptance of any proposed individual, company, or corporation shall not relieve the Contractor of his responsibility to supervise the work and to coordinate the activities of his sub-contractor with work of all other trades.

1. Sub-Contractor Qualification - No individual, company or corporation will be permitted to perform any work under this Section by Contract of sub-Contract unless such individual, company or corporation is fully qualified to perform the work. The Contractor, if requested, shall provide the following evidence that he or any of his proposed contractors or sub-contractors is qualified.
   a. State or local license, where license is required by law.
   b. Membership in trade or professional organizations;
      1) Associated Landscape Contractors of America;
      2) American Association of Nurserymen, or
      3) Florida Nurserymen and Growers Association.
   c. List of three (3) similar projects which the individual, company or corporations performed under contract or subcontract to a general contractor.

C. All plant material shall have both common and scientific names and conform to the current industry standard. Names of varieties not included therein conform generally with names accepted in the nursery trade.

D. Correct Grade of Plants: Any supplier of materials misrepresenting the grade or quality of their materials (i.e. a higher grade than they are), as determined by the Landscape Architect through the application of the Plans and Specifications, shall not be allowed to supply any material for this project. All material already supplied and received from such a supplier, which is below specified grade, shall be removed and replaced at no additional cost to the owner. This requirement for removal and replacement shall also include any installed materials. No further materials will be accepted from such supplier until written evidence is submitted and confirmed that all material for delivery is of the grade or quality represented.

1. Grade and Quality:
   a. All plant material shall be nursery grown, and comply with all required inspections, grading and quality standards and plant regulations as set forth in the Florida Department of Agriculture's "Grades and Standards for Nursery Plants, 2015 Edition, Part 1 and Part 2", or with any superseding specifications that may be called for on the Plans or in the Specifications and as established by the Turfgrass Producers Association of Florida, Inc., ALL PLANTS NOT LISTED IN THE GRADES AND STANDARDS FOR NURSERY PLANTS, shall conform to a Florida No. 1 as to: (1) health and vitality, (2) condition of foliage, (3) root system, (4) freedom from pest or mechanical damage and (5) heavily branched and densely foliated according to the accepted normal shape of the species or sport.

2. Requirements for Various Plant Designations:
   a. Balled and Burlapped (B&B) Plants:

      1) Burlap and other wrapping materials made of natural, biodegradable materials shall be used.
   b. Growing site inspections shall be requested in writing with 48 hours advance notice by the Contractor.
   c. The fact that the Landscape Architect has not made an early inspection and discovery of faulty work or of work omitted, or of work performed which is not in accordance with the contract requirements, shall not bar the Landscape Architect from subsequently rejecting such work.
   d. The Landscape Architect's on-site inspections shall be for the purpose of verifying that the Plans and Specifications are being implemented properly only. The Landscape Architect's on-site inspections are not for safety on or off the job site. Job site safety is the sole responsibility of the Contractor.

E. The Landscape Architect shall have the right, during any phase of the work operations, to reject any and all work and materials which do not meet the requirements of the Plans or Specifications. Rejected work and materials shall be immediately removed from the project area and replaced with acceptable work and material within seven (7) calendar days or as approved by the owner.

## 1.4 DELIVERY, STORAGE AND HANDLING

A. Movement of nursery stock shall comply with all Federal, State, and local laws and regulations.

B. Wrap rootball with burlap – or grow bag - if root ball is not sufficiently compacted. Palms will not require burlap wrapping if the following requirements are met:

1. Dug from marl or heavy soil that adheres to roots and retains shape without shattering.

2. Moistened material used to cover ball and roots not exposed to wind and sun.

3. Transport material on vehicles large enough to allow plants not to be crowded. Plants shall be covered to prevent wind damage during transit and shall be kept moist, fresh and protected at all times. Such protection shall encompass the entire period that the plants are in transit, being handled, or are in temporary storage.

C. All plant material shall be installed within 48 hours of delivery to site.

## 1.5 TESTING

A. The Contractor will provide services of a Testing Laboratory to perform specified tests, inspections, instrumentation, and inspection of work.

B. Tests of Materials:

1. Soil Classification:
   a. One test from each type of material encountered or proposed to be used.

2. Laboratory Tests for Moisture-Content and Density According to ASTM D1557; particle size according to ASTM D422 and ASTM D6913
   a. One test for each material encountered or proposed to be used.

3. Field Tests for:
   a. Moisture-Content and Density; according to ASTM D1556 or ASTM D2922, one test per layer of fill per 10,000 square feet of area, plus one test per 10,000 square feet of Subgrade in cut.
   b. Particle Size; according to ASTM D422, ASTM D6913

4. Laboratory Tests for Planting Soil and Topsoil Mixtures:
   a. As specified.

C. Planting soil and topsoil mixture may be inspected at any stage of operation to determine compaction characteristics, densities, and freedom from organic and plastic materials, at no extra cost to the owner.

**1.6 ACTION SUBMITTALS**

A. Written requests for approval to substitute a material's plant designation [Collected Species (CS), Balled and Burlapped (B&B), Container Grown (CG), etc.], type, grade, quality, size, quantity, etc., due to the non-availability of the material specified, shall be submitted within 30 calendar days before plant installation. Approval shall be given by the Landscape Architect before the material is delivered and installed on the project.

B. Any request for the approval of an equal shall be in writing. Requests shall be submitted within 14 calendar days after the preconstruction conference. Approval shall be given by the Landscape Architect, in conjunction with the owner, before the material is delivered and installed on the project.

C. Submit prints of shop drawings for any special conditions not covered in the details indicated. This shall be for approval by the Landscape Architect before they are installed on the project.

D. Submit a written schedule of sources or suppliers of all materials for inspection and approval by the Landscape Architect before they are delivered and installed on the project. Two color photographs in PDF format of all Trees and Palms specified on the plans, showing different side views of the item shall be submitted with the schedule. Additional color photographs of other plant material shall be submitted, if requested.

E. Submit a letter indicating the sources or suppliers of all sod and the grade to be supplied for approval by the Landscape Architect before it is delivered and installed on the project.

F. Before delivery to site, the CONTRACTOR shall submit, to both the Landscape Architect and the Town, samples and SOIL ANALYSES including particle size distribution, soil PH, composition, porosity/water retention, per the S.S.S. A. Handbook of Agricultural Soil Testing standards, or approved equal, of the following soils:

1. Existing Soils – at least five boring samples on project site at location approved by the Landscape Architect.

2. Stockpiled topsoil (if any).

3. All planting soil types for approval by the Landscape Architect before the material is delivered and installed on the project. An additional test shall be required, at no extra cost to the owner, of the planting soil after delivery.

G. Submit a sample and analysis of mulch for approval by the Landscape Architect before the material is delivered and installed on the project.

H. Submit copies of the manufacturer's specifications or analysis for all fertilizer including data substantiating that proposed materials comply with specified requirements. This shall be for approval by the Landscape Architect before the material is delivered and installed on the project.

I. Staking and guying methods shall be as shown on the plans. If revisions are required given special on-site conditions, the Contractor shall submit shop drawings for review and approval by the Landscape Architect before they are implemented on the project.

J. Submit a schedule for spraying and dusting of materials to be used to control pests and disease infestation, the reason for their use and the method to be used to apply the materials, and the method of application before it is delivered and used on the project. Also, if requested by the Landscape Architect or owner, furnish documentation that the implementation of these control measures for pests and disease infestation is in strict compliance with all federal and local regulations.

**1.7 SUBSTITUTIONS**

A. Substitutions of plant types or change in the size of plant material will only be permitted upon submission of documented proof that the particular plant type and size specified is not obtainable in Florida nurseries.

B. Where B&B plants are specified, CG plants of the same species, etc., will not be accepted. Where a B&B is not specified on a particular plant material, B&B, or CG plants may be used provided they meet all specifications.

**1.8 GUARANTEE**

A. All trees and palms shall be guaranteed for a minimum of one (1) calendar year from the time of final acceptance of the project. Landscape maintenance shall be for 1 year post final acceptance in conjunction with the guarantee for all plant materials.

B. All shrubs and groundcover shall be guaranteed for six (6) months from the time of final acceptance of the project.

C. Landscape maintenance shall be for 1 year post final acceptance in conjunction with the guarantee for all plant materials. Final approval shall be by the Town.

**1.9 REPLACEMENT**

A. The guaranteeing of plant material shall be construed to mean the complete and immediate replacement of plant material if it is:

1. Not in a healthy growing condition, and not contributing to the aesthetic appearance of the project, as determined by the Landscape Architect or the owner.

2. There is a question to its survival ability at the end of the guarantee period.

3. It is dead.

B. The Town retains the right, in case of questionable health and recovery of the plant materials, to extend the guarantee for an additional six (6) months.

**1.10 SIZE, QUALITY AND GRADE OF REPLACEMENT**

A. A. Replacement plant material shall be of the same species, quality, and grade as that of the plant to be replaced. The size of the replacement shall be the same size as the existing plant material in the landscape of the same species. Replacements shall be guaranteed for a period equal to the originally specified guarantee. This guarantee period shall begin at time of plant replacement.

**1.11 GUARANTEE NULL AND VOID**

A. The guarantee shall be null and void for plant material which is damaged or dies as a result of "Act of God" limited to hail, freeze, lightning, winds which exceed hurricane force, and lethal yellowing, providing the plant was in a healthy growing condition prior to these "Acts of God".

**1.12 UNIT PRICES**

A. The successful bidder shall furnish a unit price breakdown for all materials to the owner's Representative. The Landscape Architect may, at his discretion, add to or delete from the quantity of materials utilizing the unit price breakdown submitted to and accepted by the owner. Unit prices shall be valid for the entire construction period.

**PART 2 - PRODUCTS**

**2.1 PLANT MATERIAL**

A. Except where another grade is specifically called for in the Plans, all plant material shall be Florida No. 1, or better, per the current Dep't of Agriculture Grades and Standards Manual, at the time of installation and final acceptance.

B. Containerized material shall be well established with at least one (1) full growing season in its container. Field grown material shall be well established with at least two (2) full growing seasons in its existing location.

C. Habit of Growth: All plant material shall have a habit of growth that is normal for that species and shall be sound, healthy, vigorous and free from insects, plant diseases and injuries.

D. Measurement of Trees, Palms, Shrubs & Ground Cover:

1. Trees, Shrubs and Ground Cover:

a. Rootball: Requirements for the measurement of rootball diameter and depth shall comply with requirements as set forth in the latest edition of the Florida Department of Agriculture's "Grades and Standards for Nursery Plants, Part 1 and Part 2. **NO TREES OR PLANTS WITH ROOT GIRDLING,** defined by the main roots wrapped greater than 1/3 the diameter of the plant container **SHALL BE ACCEPTED.**

b. Height: The height of plant material shall be measured from finish grade and continue up to where the main mass of the plant uniformly ends. The height shall not include any singular or isolated parts of the plant, such as leaves, shoots, branches, limbs or fronds, which extend out beyond the main mass of the plant.

c. Width: The width of plant material shall be measured from one side of where the main mass uniformly ends and continue to the other side of where the main mass of the plant uniformly ends. The width shall not include any singular or isolated parts of the plant, such as leaves, shoots, branches, limbs, or fronds, which extend out beyond the main mass of the plant.

d. Caliper: The caliper of tree trunks shall be measured 3' above the ground unless:

1) The landscape regulations, ordinances, and code requirements from the appropriate local jurisdiction the project is located in indicate another method of measurement.
2) Another method of measurement is indicated otherwise on the Plans.

2. Palms: Requirements for the measurement of clear trunk, clear wood, graywood, rootball diameter and depth shall comply with requirements as set forth in the latest edition of the Florida Department of Agriculture's "Grades and Standards for Nursery Plants, Part 2".

E. All sizes shown for plant material on the Plans are to be considered as minimums. All plant material must meet or exceed these minimum requirements for height, spread, etc. as indicated on the Plans. When plant sizes are specified as a range of size, installed material shall average the mean of the range specified. Plant materials which exceed the minimum dimensions shall not constitute a means for additional compensation to the Contractor or dispensation from other portions of the work.

F. Die-Back and Leaf-Drop: Plant material showing signs of die-back or leaf-drop will not be accepted and must be removed from the project immediately, if so, directed by the Landscape Architect. Therefore, any plant material with tendencies toward leaf-drop or die-back must be root pruned early enough to provide a sound network of hair roots prior to relocation.

G. Mechanical Destruction of Foliage: Mechanical destruction of foliage resulting from improper handling with tools or equipment shall not affect more than 10% of the total foliage prior to planting on the project. Loss of foliage caused by seasonal change will be accepted.

H. Palms:

1. Before Transporting: See "Delivery and Handling" for requirements related to wrapping of root balls.

2. Remove a minimum of fronds from the crown of the palms to facilitate transporting and handling.

3. Palms with burn marks on trunk will not be accepted.

4. Using biodegradable material, such as a burlap strip or untreated cotton twine, tie Sabal palmetto bud and leave in-place until palm is established. If by this time the bud has not opened naturally, then the Contractor shall remove the tie, including any bracing, even if the project has been completed, final acceptance has been given and the Contractor has left the job. There shall be no separate, additional compensation for this task. Tying shall be as set forth in the latest edition of the Florida Department of Agriculture's "Grades and Standards for Nursery Plants". Tying of other palms shall be at the option of the Contractor.

5. Tapering of palm fronds to reduce head volume shall not be accepted.

6. Palms showing cable or chain marks and equipment scars shall be rejected.

I. Chlorosis: The allowable level of Chlorosis in foliage shall be set forth in the latest edition of the Florida Department of Agriculture's "Grades and Standards for Nursery Plants".

J. Plant material shall not be accepted when the ball of earth surrounding its roots has been cracked, broken or otherwise damaged.

K. Root pruning of plant material, when necessary, shall be done a minimum of six (6) weeks or for a period as determined by the Landscape Architect, prior to planting at the project. Prior to root pruning, the Contractor shall give 48-hour advance notice to the Landscape Architect advising of the date to root prune any plant material. This shall allow for any inspections during or after the root pruning, if necessary.

**2.2 SOD**

A. Sod shall be Bermuda grass ‘Celebration’ or ‘Latitude 36” approved equal by the Landscape Architect. The quality grade shall be PREMIUM - no weeds or any other grass allowed; only the species of sod specified.

1. Quality grade shall be based on the standards of sod quality grades as established by the TURFGRASS PRODUCERS ASSOCIATION OF FLORIDA, INC. The sod shall be well matted with roots and of firm, tough texture having a compact top growth and heavy root development.

2. Sod sections shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10% of the section. Sod shall be moist and relatively free of thatch, up to one half inch allowable (uncompressed). The soil embedded in the sod shall be a clean earth free of stones and debris.

B. Mowing: The sod shall have been mowed at least three times with a lawn mower with final mowing not more than seven days prior to the sod being cut for placement.

C. Cutting: Sod shall not be harvested when moisture content (excessively dry or wet) may adversely affect its survival and shall be live, fresh and uninjured at the time of placement. After approval of source, mow and rake as necessary to remove excessive top growth and debris. Cut sod with mechanical sod cutters, retaining native soil mat of sufficient thickness to withstand handling. The sod shall be provided in commercial pad sizes measuring not less than 12" by 24" with a uniform thickness of 1 inch to 3/4 inches at time of cutting. Measurement for thickness shall exclude top growth and thatch.

D. Delivery: Deliver sod on pallets with root system protected from exposure to wind and sun, in quantities not greater than what the Contractor is capable of installing within 48 hours of cutting. It shall be planted within 48 hours after being cut and shall be shaded and kept moist from the time it is cut until it is planted.

E. Handling: Handle sod in a manner to prevent dislodging soil mat. Pitchforks, dumping of pallets from vehicles and tearing of sod are prohibited.

**2.3 PLANTING SOILS**

A. PLANTING SOIL shall be natural, friable, and free from rocks larger than 1/2" diameter, weeds, stumps, plant tissue, litter, toxic substances, or any other deleterious materials. The Planting soil shall consist various types, including the following:

1. **Type 1** – **General Landscape** - 70% clean, coarse, sharp, Lake Wales Silica Sand (alternate: Ortona or FDOT #3 coarse silica sand) and 30% Everglades muck mixed with the approved, native, soil in a 3:1 ratio. Soil must be taken from ground that has never been stripped, with a slight acid reaction (5.5 to 6.5 ph) and without an excess of calcium or carbonate. Soil shall be delivered in a loose friable condition.

2. **Type 2** – **Sod Soil Blanket** (at all SOD areas) 90% clean, coarse, sharp, Lake Wales Silica Sand (alternate: Ortona or FDOT #3 coarse silica sand) and 10% Everglades Muck.
   a. The SOD SOIL BLANKET shall be natural, friable, and free from rocks larger than 1/2" diameter, weeds, stumps, plant tissue, litter, toxic substances, or any other deleterious materials.

| Screen Size | % |
|---|---|
| #16/1-18 mm | 6 |
| #30/.60 mm | 51 |
| #50/.30 mm | 87 |
| #100/.15 mm | 98 |
| #200/.75 mm | 99 |
| **FM** | **2.42** |

B. Contractor shall provide soil test / analysis as required of all soils used for planting and shall be supplied by independent and certified testing laboratories, independently mailed to the Town and Landscape Architect prior to the delivery and/or use of the soil.

**2.4 WATER**

A. The Landscape Contractor is responsible to ascertain the location and accessibility of a potable water source. The Landscape Contractor is responsible for distribution of water to the areas of planting. All new plants shall be irrigated for establishment purposes as required, by Water Truck or other temporary irrigation system as supplied by the General Contractor, until the irrigation system is fully operational. If there is no source of potable water available at the job site approved for use, then the Landscape Contractor shall be responsible for bringing in a water truck or tank for hand watering. If water volumes, accessibility and distribution are not satisfactory to the Contractor, it is his responsibility to negotiate acceptable terms with the owner prior to signing of a contract. If during the planting, water availability previously agreed to, is curtailed, the Contractor shall notify, in writing within 24 hours, the owner of the condition and, if the Landscape Contractor deems necessary, his intent to cease work until water is restored. For plants already installed prior to cut-off of water availability, the Landscape Contractor shall continue to be responsible for providing water as required by specifications.

**2.5 MULCH**

A. Mulch shall be processed entirely from the Melaleuca tree and composed of 97% hard inner wood and 3% outer bark. It shall be naturally colored, uniformly shredded and free from foreign matter, large pieces of bark, tree stump material, burrowing nematodes and ants. (Melaleuca mulch must have a written guarantee that there will be no germination of Melaleuca seed present in the mulch. If germination occurs, the Contractor shall be responsible for removal of the mulch and seedlings to the satisfaction of the Landscape Architect. The mulch shall be replaced with another acceptable mulch approved by the Landscape Architect).

**2.6 FERTILIZER**

A. Submit copies of the manufacturer's specifications or analysis of all fertilizer for approval.

B. Trees and Palms (Container): Fertilize per manufacturer’s recommendations during Maintenance Period. Shall be a “8-2-12” ‘Palm Special’ formulation (as available at Atlantic FEC Fertilizer: (305) 247-8800), with a minimum of 50% nitrogen in the slow-release (preferably sulfur-coated) and a complete line of micro-nutrients, or approved equal.

C. Shrubs and Ground Cover: Fertilize per manufacturer’s recommendations during Maintenance Period. Shall be an “8-2-12” ‘Palm Special’ formulation, with a minimum of 50% nitrogen in the slow-release (preferably sulfur-coated) and a complete line of micro-nutrients release (preferably sulfur-coated), or approved equal.

1. Sensitive Plant Beds – such as Ferns and Orchids, see Maintenance Specifications below Section 3.9 (B).

D. Fertilizer for sod shall be as recommended in the Maintenance Specifications below Section 3.5 (G), or an approved equal by the Landscape Architect.

E. Rates of Application: Sod shall be fertilized at the rate of 1.0 lb. of actual potassium per 1,000 square feet of area.

F. Submit manufacturer's specification sheet(s) for approval of product. Submit tags from bags of fertilizer used on site to the Town and Landscape Architect.

G. Composition and Quality: All fertilizer shall be uniform in composition and dry. Granular fertilizer shall be free flowing and delivered in unopened bags. Tabletized fertilizer shall be delivered in unopened containers or boxes. All bags, containers or boxes shall be fully labeled with the manufacturer's analysis.

H. All shall comply with the State of Florida fertilizer laws.

I. Submit herbicide type for approval by Landscape Architect.

**PART 3 - EXECUTION**

3.1 **INSPECTION**

A. Prior to the work, carefully inspect the installed work of other trades and the site conditions and verify that all such work and site conditions are complete to the point where this installation may properly commence.

B. Start of work shall imply acceptance of the site conditions.

C. Utilities (Overhead and Underground).

1. The work area may have existing utilities, such as, but not limited to, irrigation, phone, electrical and storm sewer. It shall be the responsibility of the Contractor to verify the location of all such utilities, structures, etc., by hand excavation or other appropriate measures before performing any work that could result in damage or injury to persons, utilities, structures or property. The Contractor shall make a thorough search of the site for utilities, structures, etc., before work is commenced in any particular location.
2. The Contractor shall take immediate steps to repair, replace, or restore all services to any utilities or other facilities which are disrupted due to his or her operations. Further, the Contractor shall engage any additional outside repairs on a continuous "around the clock" basis until services are restored. He or she shall also provide and operate any supplemental temporary services to maintain uninterrupted use of the facilities. All costs involved in the repairs and restoring of disrupted service resulting from negligence on the part of the Contractor shall be borne by the Contractor and he or she shall be fully responsible for any and all claims resulting from the damage.

3. Should utilities, structures, etc., be encountered which interfere with the work the Landscape Architect shall be consulted immediately in order for a decision to be made on the relocation of the work so it will clear the obstruction, if the obstruction cannot be relocated.
4. The Contractor shall not purposefully disrupt or disconnect any type of utility whatsoever without first obtaining the written permission of the Landscape Architect. Requests for disconnection must be in writing and received by the Landscape Architect at least 72 hours prior to the time of the requested interruption.

## 3.2 GRADES

A. Rough Grades: Grading for drainage, swales, etc. shall be provided by the Engineer.

B. It shall be the responsibility of the Contractor to provide the final grading so the final level for planting areas conforms to surrounding grades and is at the proper elevation with relation to walks, paving, drain structures and other site conditions, unless indicated otherwise on the Plans.

C. Plant Areas Next to Pavement: All planting areas next to pavement areas, such as, but not limited to, curbs, roads, drives, walks, terraces, decks and slabs shall be set so that the TOP OF THE MULCH IS 1" BELOW THE TOP OF THE PAVEMENT AREA or as indicated otherwise on the Plans, and the top of sod is level with the top of pavement area, measured from the top of pavement to the top of grass blades after mowing.

## 3.3 HERBICIDE TREATMENT

A. In all areas infested with weed and/or grass growth, a herbicide as approved by the Landscape Architect shall be applied per manufacturer's rates. When it has been established where work will be done, the herbicide shall be applied in accordance with manufacturer's labeling to kill all noxious growth. Landscape Contractor shall schedule his work to provide a minimum of two (2) applications, or more if required, to obtain at least 95% kill of undesirable growth. Landscape Contractor shall exercise extreme care to prevent damage to desirable existing growth. If necessary, Landscape Contractor shall conduct a test to establish suitability of product and applicator to be used on this project, prior to execution of the full application.

B. The Contractor shall notify the Landscape Architect of the scheduled herbicide treatment a minimum of 48 hours prior to application.

## 3.4 PREPARATION

A. Subsurface Conditions: Some or all work areas may be compacted and/or contain existing material such as limerock which may interfere with adequate vertical drainage and/or proper plant survival and growth and therefore removal of this material is part of the scope of work for the project. The Contractor shall be responsible for ensuring adequate drainage in these areas and shall remove this existing material, as required, by such means as augering, drilling or rototilling.

B. All soils below 12” of finished grade, shall be compacted no more than 80-85%.

C. The Contractor shall remove all existing concrete, asphalt, concrete and rocks, above and below grade, from areas to be landscaped unless indicated otherwise on the Plans.

D. The rootballs of B&B plants which cannot be planted immediately shall be covered with moist soil or mulch to insure protection from drying winds and sun. All plants shall be maintained as necessary until planting. Refer to the section entitled "DELIVERY, HANDLING AND STORAGE" for additional requirements.

E. All areas proposed for planting not covered by more than 12" of new fill shall be scarified by an approved means to a depth of not less than 36" and shall be treated with two separate applications of appropriate herbicide as recommended by the manufacturer and approved by the Landscape Architect.

F. Staking Plant Locations: Stake or mark plant material locations prior to plant hole excavation, based on information from the Plans. Landscape Architect to approve all staked locations prior to installation.

G. Spacing of Ground Cover and Shrubs: The location of a planting bed (shrub or groundcover) next to another bed, walkway, structure, etc., shall have the plants along the perimeter spaced so that the plants can mature properly without growing into the other bed, walkway, structure, etc.

H. No composted yard waste shall be used.

I. Excavation of Planting Pits:

1. General:
   a. The planting pit shall be cylindrical in shape with the sides approximately vertical. The Landscape Architect reserves the right to adjust the size and shape of the plant hole and the location of the plant in the hole to compensate for unanticipated structures or un-anticipated factors which are a conflict.
   b. The excavated Native Soil from the planting pits shall be mixed with planting soil indicated under "2.3 PLANTING SOIL” in a 1:1 ratio to backfill the planting pit. Extra material shall be disposed of either on the project site or off the site, as directed by the Landscape Architect.

2. Trees and Palms:
   a. Depth of planting pit shall be one (1) inch less than the rootball height.
   b. Diameter of pit shall be two (2.0) times the diameter of the rootball.
   c. Tree / Palm to be planted with top of rootball 1” above finished grade.

3. Shrubs: (Planted 24” O.C. or greater)
   a. Depth of planting pit shall be equal to the rootball depth.
   b. Diameter of planting pit shall be 50% (1.5 times) greater than the rootball width.

4. Groundcover Beds: (planted up to 18" O.C.)
   a. Depth shall be equal to the rootball depth.
   b. Diameter: Groundcover material in mass shall not be planted in individual holes but rather in one continuous pit or excavation for the entire mass, all at a depth equal to the depth of the rootball.

5. SOD SOIL BLANKET: All sod planting areas shall have a 4" minimum layer of Type 2 Soil as specified in Part 2.3 (A) (3), placed prior to laying sod.

3.5 **INSTALLATION**

A. Container Plant Material: After container grown plant material is removed from its container, inspect the rootball for circling roots. Plants with circling roots shall not be accepted. The bottom of the root ball shall receive an "X" shaped cut that is 1/4 inch deep.

B. Setting of Plants:

1. PLANT MATERIAL SHALL BE PLANTED AT THEIR NATURAL AND ORIGINAL PLANTING LEVEL PRIOR TO THEIR PLACEMENT ON THIS PROJECT OR JOB. WHEN LOWERED INTO THE HOLE, THE PLANTS SHALL REST ON THE PREPARED HOLE BOTTOM SUCH THAT THE TOP FLARE ROOT OR SURFACE ROOTS AT THE TOP OF THE ROOTBALL ARE ONE (1") INCH ABOVE THE LEVEL OF THE SURROUNDING FINAL GRADE. THE PRACTICE OF PLUNGING, BURYING OR PLANTING ANY PLANT MATERIAL SUCH THAT THE TOP FLARE/SURFACE ROOTS ARE BELOW THE LEVEL OF THE SURROUNDING FINAL GRADE, WILL NOT BE PERMITTED UNLESS IT IS INDICATED OTHERWISE IN THESE SPECIFICATIONS OR IT IS APPROVED IN WRITING BY THE LANDSCAPE ARCHITECT PRIOR TO SUCH ACTION BEING TAKEN. The plants shall be set straight or plumb or normal to the relationship of their growth prior to transplanting. The Landscape Architect reserves the right to realign any plant material after it has been set.
2. Plant material of the shrub category and smaller must be handled by the ball only. Plant material too large for handling by hand, if moved by winch or crane, must be thoroughly protected from chain, rope or cable marks, girdling, bark slippage, limb breakage and any other damage that might occur by improper handling or negligence.
3. All trees and palms shall be handled by both the trunk and rootball at the same time and not by the trunk only. Trunks shall be thoroughly protected.
4. Container grown plant material shall be carefully removed from the container so as not to disturb the root system.

C. Backfilling:
   a. The excavated Native Soil from the planting pits shall be mixed with planting soil indicated under "2.3 PLANTING SOIL" in a 1:1 ratio to backfill the planting pit. After setting plant, fill the bottom two thirds of the surrounding planting pit with the planting soil mix and firmly tamp and settle by watering as backfilling progresses. After having tamped and settled the bottom two thirds of the hole, thoroughly

puddle with water and fill remaining one third of the hole with the planting soil mix, tamping and watering to eliminate air pockets.

D. Application Rates of Fertilizer: Shall be as recommended by the fertilizer manufacturer, or as otherwise approved by the Landscape Architect.

E. Mulch: Within 24 hours after planting. Planted areas must be mulched uniformly to a depth of two inches minimum, or as indicated on the Plans. Keep mulch approximately one inch away from trunks, stems or growing points of ground covers.

F. Staking and Guying:

1. Staking and guying shall not be attached to the plant material with nails. Staking and guying, shall be installed as indicated in the details or approved shop drawings. Refer to the heading "Setting of Plants", which is in PART 3 of these Specifications, for additional information.
2. Staking and guying shall be in accordance with the drawing, or otherwise required by all applicable regulations, ordinances and code requirements in effect at the time of award of the contract, unless otherwise approved by the Landscape Architect in the shop drawing/submittal process.
3. The decision of whether to stake or guy shall be left to the discretion of the Contractor, provided it is not required according to local regulations, ordinances and code requirements, and shop drawings have been approved. However, a Contractor's decision not to stake or guy shall not relieve he or she of the responsibility of resetting plant material if it blows, falls or leans over. Also, it will not relieve he or she of the guarantee if the material is damaged or dies as a result of blowing, falling or leaning over.
    a. The Contractor shall remove and dispose of staking and guying materials when it is determined by the Landscape Architect that sufficient time has elapsed for the plants roots to stabilize the plant at no extra cost to the owner.

G. Installation of Sod:

1. SOD AREAS: Contractor shall ensure that the specified sod soil blanket is placed prior to sod installation. Contractor shall install sod no later than two (2) days after final grading.
2. Placement of sod: Sod shall be carefully placed by hand, within specified paver blocks, per manufacturer’s recommendations. No open joints where underlying soil is visible is permitted.
3. Sanding: If, in the opinion of the Design Professional, the sod bed, after planting, is in need of an application of a sand top-dressing for reasons of irregularities or shrinking joints, the Contractor shall perform this task at no additional compensation. Contractor shall use specified sand in planting soil mix.
4. Fertilizing: Spread fertilizer over sodded areas uniformly by use of a device calibrated to distribute fertilizer at specific quantities. There is to be no nitrogen or phosphorus in sod fertilizer.

5. Watering Fertilized Sod: Wash fertilizer off the grass blades, no later than 4 hours from time of spreading.

H. Watering:

1. Initially, water the plant material to develop uniform coverage and deep water penetration of at least six inches. Avoid erosion, puddling, and washing soil away from plant roots.
2. Provide continuous watering of plant material and sod, after planting, in order to achieve optimum growth conditions to establish plants. Water shall be applied as necessary and the amount of water and frequency of watering shall be based on the specific needs of each plant type, the time of year, amount of rainfall and other environmental conditions present at the time. This watering shall begin after the plant is planted and continue until final acceptance or for a minimum of sixty (60) consecutive calendar days, whichever is greater in time. ALL TREES AND PALMS SHALL BE HAND WATERED, ONLY, DURING THIS PERIOD. DO NOT RELY ON THE IRRIGATION SYSTEM, IF THERE IS ONE, TO ACHIEVE THIS TASK. Shrubs and ground cover may be watered by using the irrigation system, if there is one, otherwise hand water during this period.
3. If there is no source for water available at the project, such as a hose bib(s) or fire hydrant(s) if approved for use, then the Contractor shall be responsible for supplying water for hand watering by means of a truck or tank.
4. Canopy watering of transplanted and proposed tree specimens, using misting heads on PVC risers to cover entire canopy, shall be required at the discretion of the Landscape Architect. Operate by hand or on a time clock to spray as required to keep soil at root ball from getting too wet.

I. Pruning and Thinning after Plant Installation:

1. The amount of general pruning and thinning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots as a result of transplanting operations. Pruning and thinning shall be done in such a manner as not to change the natural form or shape of a plant. The Landscape Architect shall be contacted prior to performing any major pruning and thinning and may elect to be present during any pruning and thinning. All tree pruning should be performed in accordance with the current ANSI A-300 pruning standards and Tree Protection and Pruning Specifications.
2. All broken or damaged branches or roots shall be cut off smoothly.
3. "Hat racking" shall not be permitted.

J. Weeding:

1. If weeds become prevalent to such an extent that they threaten the health of plant material, then they shall be removed. This condition shall apply during the construction, maintenance, and guarantee periods if the weeds were introduced by the Contractor through the plant material, planting soil, sand or mulch used.

2. If necessary, plant material, mulch, sand and/or planting soil shall be replaced as needed to eliminate weeds or undesirable vegetation at the expense of the Contractor.

K. Removal of Plant Material: All plant material to be removed, shall be removed completely, including the rootball or as directed by the Landscape Architect, from the job site. The remaining hole shall be filled with suitable material or planting soil.

## 3.6 CLEANUP

A. Disposal of Waste: All waste and other objectionable material created through planting operations and landscape construction shall be removed completely, on a daily basis, from the job site or as directed by the Landscape Architect. Any paved area, including curbs and sidewalks which contain soil, sod waste, fertilizer or other waste shall be thoroughly swept. The Town is not required to supply areas or facilities for storage or removal of waste on-site.

B. Excess Fill: All excess fill which results from the installation of the project shall remain the property of the owner and remain on the project at the option of the owner. All excess fill which the owner does not want shall be removed and disposed of from the project at no additional cost to the owner. No excess fill shall be removed or disposed of from the site until approved by the Landscape Architect. Excess fill shall be disposed of as directed.

C. General contractor should replace all sod damaged in the swale / Right of Way as a result of the construction activity.

## 3.7 PROTECTION

A. Responsibility for Protection and Restoration of Property: The Contractor shall be responsible for all damage or injury to person or property.

B. Protection Against Mechanical Damage: The Contractor's responsibility for protection against mechanical damage shall include providing protection from vehicles and providing warning signs and barricades as might be necessary and he or she shall repair, restore and replace all property which becomes damaged as a result of any negligence of the Contractor or his or her employees in complying with these requirements. Coordination shall be with the Town and the Landscape Architect.

## 3.8 COMPLETION AND FINAL ACCEPTANCE

A. Upon written notice from the Contractor of the presumptive completion, as defined below, of the entire project, the Landscape Architect, along with other appropriate parties, will make an inspection within 48 hours after the written notice. If all construction provided for and contemplated by the Plans and Specifications, is found to be completed in accordance with the Plans and Specifications, such inspection shall constitute the final inspection. The Contractor shall be notified in writing of final acceptance as of the date of the final inspection.

B. If, however, the inspection mentioned in paragraph A above, discloses any work, in whole or in part, as being unsatisfactory, final acceptance shall not be given the Contractor. The Landscape Architect will give to the Contractor the necessary instructions or "punch lists" for correction of same, and the Contractor shall have up to 20 calendar days from the date such instructions or "punch lists" to correct the work received. If the instructions or "punch lists" to correct the work are not complete within the 20 calendar days, then the owner may correct the work and back-charge the Contractor for materials, labor and equipment.

C. Upon correction of work, another inspection will be made which shall constitute the final inspection, provided the work has been satisfactorily completed. In such event, the owner or their representative shall make the final acceptance and notify the contractor in writing of this final acceptance as of the date of this final inspection.

D. Completion of the work shall mean the full and exact compliance and conformity with the provisions expressed or implied in the Plans and Specifications including any and all "punch lists" which may be issued outlining certain items of work which were found unsatisfactory or require completion or correction action.

E. Final acceptance shall not be given until all construction provided for and indicated in the Plans and Specifications is inspected by the Town and found to be completed in accordance with the Plans and Specifications.

F. Final acceptance shall not be official until acknowledged in writing by the Town.

G. The guarantee shall not begin until the day final acceptance is given.

3.9 RESPONSIBILITY PRIOR TO FINAL ACCEPTANCE

A. Certain responsibilities prior to final acceptance: The following is a partial list of certain responsibilities. It is not a complete list, but only a summary of certain responsibilities. There are other responsibilities indicated elsewhere in the Plans and Specifications. The lack of listing a responsibility on the following list does not relieve the contractor of that responsibility if it is indicated elsewhere in the Plans and Specifications. Also, the listing of a responsibility on the following list does not necessarily make it any more important that one which is not listed:

1. The Contractor is responsible for the entire project prior to final acceptance.
2. The Contractor is responsible for safety on and off the job site.

B. Maintenance Prior to Final Acceptance:

1. Maintenance shall begin immediately after each plant is planted and continue until final acceptance except for the watering indicated in the paragraph below. This watering shall begin as indicated and shall continue until completed, even if the indicated period goes beyond the time of final acceptance.

2. Plant maintenance shall include watering, pruning, weeding, cultivating, repair of erosion, mulching, tightening and repairing of guys, stakes, braces, etc., replacement of sick or dead plants, resetting plants to proper grades or upright position, maintenance of the watering saucer, litter removal, and all other care needed for proper growth of the plants. Mowing and edging shall be done at least every fourteen (14) days and the irrigation system shall be checked every fourteen (14) days. Contractor shall issue a field report with recommended repairs to responsible subcontractor within 48 hours.

3. Immediately after planting, each plant shall be watered and the watering period shall continue until final acceptance. Refer to the section entitled "Watering" for additional requirements.

4. WEEDING: All plant material shall be weeded once a week. In the event that weeds or other undesirable vegetation becomes prevalent to such an extent that they threaten plant material, the weeds shall be removed as directed by the Design Professional. If necessary, the plant material, mulch, sand and/or planting soil shall be replaced as needed to eliminate weeds or undesirable vegetation at the expense of the Contractor. This condition shall apply during the construction, maintenance and guarantee periods.

5. PESTICIDE/HERBICIDES:
   a. Contractor shall use Integrated Pest Management as the guideline for pest control. All other strategies shall be used prior to chemical use and the least toxic chemical applied when done.
   b. When a chemical is being applied, the person using it shall have in their possession all labeling associated with the chemical. Also, the chemical shall be applied as indicated on the said labeling.
   c. The spraying of pesticides and other such chemicals are to be confined to the individual plant. Spraying techniques which may cause drift or runoff beyond the target site is strictly prohibited.
   d. The implementation of control measures for pests and disease infestations shall be in strict compliance with all federal and local regulations. Upon request, the Contractor shall furnish documentation of such compliance.
   e. All pesticides shall be applied by a Certified Pest Control Operator. The operator shall have the license/certification in their possession insecticides are being applied.

6. Protection: Planted trees and plants shall be protected against trespassing and damage. If any plants become damaged or injured, they shall be treated or replaced as directed and in compliance with the specifications at no additional cost to the Owner. No work shall be done within or over planting areas or adjacent to plants without proper safeguards and protection.

7. Keep sidewalks, curbs and gutters, drainage structures, driveways, parking areas, streets, terraces, decks and pavers free of plant cuttings, debris and stains.

8. Plant Material rejected during the course of construction shall be removed with ten (10) working days and replaced as required before an inspection for completion will be scheduled.

9. If the Contractor fails to perform maintenance consistent with these specifications, as determined by the Town or Landscape Architect, then the Town may perform any necessary maintenance and back charge the Contractor for labor and materials.

C. Survival and Conditions: The Contractor shall be responsible for the proper maintenance and the survival and condition of all landscape items from the time a landscape item is installed until final acceptance.

D. Replacement: Replacement of plant material shall be the responsibility of the Contractor including the possible replacement of plant material resulting from removal by theft or vandalism or acts of negligence on the part of others. All plant material shall be alive and in good growing condition for each specific kind of plant at the time of final acceptance.

**END OF SECTION**

# SECTION 329413 - LANDSCAPE EDGING

## PART 1 - GENERAL

### 1.1 SECTION INCLUDES

A. Landscape edging for straight-line and curvilinear borders between turf and planting beds, mulch beds, stone/rock beds, and stabilized aggregate pathways and plazas.

### 1.2 REFERENCES

A. ASTM B 221 (ASTM B 221M): Standard Specification for Aluminum and Aluminum - Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

B. ASTM B 209-01 (ASTM B 221M): Standard Specification for Aluminum and Aluminum – Alloy Sheet and Plate.

C. AAMA: American Architectural Manufacturer's Association for aluminum finishes.

### 1.3 SUBMITTALS

A. Submit manufacturer's product data.

B. Submit 3 inch (76 mm) long edging sample of specified size and colors.

### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver to location as instructed by Contractor in manufacturer's package showing no signs of damage to product.

B. Investigate delivered damaged packages and if product is damaged, Contractor to not accept and have product returned and replaced. Store boxed products on flat surface and protect from water exposure.

### 1.5 WARRANTY

A. 15-year limited material warranty for manufacturing defects in workmanship or material.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

A. LANDSCAPE EDGING: PermaLoc Corporation, 13505 Barry St, Holland, MI 49424, USA, telephone: (800) 356-9660, (616) 399-9600, fax (616) 399-9770, e-mail: info@permaloc.com, web site: www.permaloc.com

B. ALTERNATE LANDSCAPE EDGING: Sure-loc Edging Corporation, 494 E. 64th St, Holland, MI 49423, USA, telephone: (800) 787-3562, www.surelocedging.com

### 2.2 MANUFACTURED UNITS

A. Heavy Duty Straight Profile Aluminum Edging:
   1. Description: PermaLoc CleanLine, or approved equal, extruded aluminum landscape edging for straight-line and curvilinear applications in corrugated straight profile. Section shall have loops on side of section to receive stakes spaced approximately 2 to 3 feet (610 mm to 915 mm) apart along its length.
   2. Size: 3/16” thick x 4” (4.8 mm x 102 mm)
   3. Thickness: 3/16 inch (4.8 mm) gage section at 0.116 inch (2.95 mm) minimum thick with 0.187 inch (4.75 mm) exposed top lip.
   4. Length: 16 feet (4.88 meters). Selected products in 8 foot (2.44 meters) sections.
   5. Connection Method: Section ends shall splice together with an interlocking stakeless snap-down design.
   6. Finish: Natural Mill Aluminum

### 2.3 STAKES

A. Standard Gage Stake: 12 inch (305 mm) PermaLoc, or approved equal, aluminum or steel, 0.10 inch (2.5 mm) thick x 11.81 inches (300 mm) long x 1.12 inches (28.4 mm) wide.

B. Stakes to interlock into section loops on face side of section. Requires 5 stakes for each 16 feet (4.88 meters) section with total of 8 loops available or 3 stakes for each 8 feet (2.44 meters) section with total of 3 loops available.

C. Finish: Shall be same as edging.

### 2.4 EDGING AND STAKE MATERIAL

A. Landscape Edging: ASTM B 221 (ASTM B 221M) Aluminum 6063 alloy, T6 hardness.

B. Landscape Stakes (12"(305 mm)): ASTM B 209-01 (ASTM B 209M), Aluminum 3004 alloy, H34 hardness.

## PART 3 - EXECUTION

### 3.1 PREPARATION

A. Ensure that all underground utility lines are located and will not interfere with the proposed edging installation before beginning work.

B. Locate border line of edging with string or other means to assure border straightness and curves as designed.

C. Dig trench 1 inch (25 mm) deeper than set of edging bottom.

### 3.2 INSTALLATION

A. Set edging into trench with top at ½ inch (12.7 mm) above compacted finish grade on turf side with side having loops for stakes placed on opposite side of turf (or on turf side for maintenance strip).

B. Securely connect sections together in accordance with manufacturer's instructions. Drive stakes through edging loops with spacing in accordance with manufacturer's recommendations until locked into edging with stake top 1/8" (3.2 mm) below top of edging. Provide additional stakes, longer stakes, heavier gage stakes, or any combination of previously mentioned as necessary to firmly secure edging for permanent intended use.

C. Where edging sections turn at corners and at angled runs, cut edging partially up through its height from bottom and turn back to desired angle to form rounded exposed radius.

### 3.3 BACKFILLING AND CLEANUP

A. Backfill both sides of edging, confirm and adjust if necessary that sections are securely held together, and compact backfill material along edging to provide top of edging at ½ inch (12.7 mm) above yard finish grade.

B. Cleanup and remove excess material from site.

**END OF SECTION**

# SECTION 329414 - ROOT BARRIER

## PART 1 - GENERAL

### 1.1 SCOPE

A. The work in this section shall include but not be limited to the following:
   1. Provide for the purchase and on-site delivery of root barrier listed in the planting schedule and shown on the drawings.
   2. Provide all labor, tools, and materials for the installation of root barrier.

### 1.2 QUALITY ASSURANCE

A. All pre-packed items shall remain in their original containers until such time when the actual installations will take place. Said items shall be stored as necessary to prevent damage and shall be in new condition at the time of installation.

### 1.3 ACTION SUBMITTALS

A. Shop Drawings - Submit shop drawings to show component parts, fabrication, installation, and dimensions for all furnishings.

### 1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer warranty, and assembly instructions, specifications, etc., for all factory products.

### 1.5 COORDINATION

A. Contractor shall be responsible for verifying all dimensions and required hardware for the root barrier, and to coordinate its installation with other site improvements.

## PART 2 - PRODUCTS

A. Root Barrier: Provide UB 18-2 (18” wide) Linear Barrier as manufactured by DeepRoot (1-800-APS-5558). Alternate root barrier: ReRoot 300 as manufactured by GreenBlue Urban (1-866-282-2743).

**PART 3 - EXECUTION**

3.1 **ROOT BARRIER**

A. Contractor shall install per Manufacture recommendations.

**END OF SECTION**

# SECTION 329600 - TRANSPLANTING

## PART 1 - GENERAL

### 1.1 SUMMARY

A. The work includes, but is not limited to;
   1. Transplanting of vegetation in conflict with proposed paving areas, pathways, and structures, as identified in the Drawings or as directed by the Landscape Architect.
   2. Maintenance of transplanted plant material.
   3. Pruning of roots and tree limbs of transplanted material as required.

### 1.2 PERMITS AND CODES

A. The Contractor shall obtain all permits as prepared by the Design Team, including the Tree Removal Permit from Miami-Dade County, the Town of Surfside and all other applicable agencies necessary to accomplish the work.

B. The Contractor shall be responsible for performing work in accordance with applicable regulations, ordinances and code requirements from the city, county, state and/or federal agency having jurisdiction over any portion of the work.

## PART 2 - PRODUCTS

### 2.1 GENERAL RELOCATION

A. Shall consist of relocation of plant material presently conflicting with areas designated for paving of roads, parking areas, structures and pathways as shown on the drawings. Such plant material will include all trees with calipers as identified on the drawings. Existing and proposed locations of transplanted material is shown on the drawings.

### 2.2 STAKING & GUYING

A. See Landscape Plans.

### 2.3 TREE PROTECTION FENCE

A. Place tree protection fence as shown on the drawings. Maintain fences as shown until final project acceptance.

**2.4 PLANTING SOIL of TRANSPLANTED TREES AND PALMS**

A. Soil shall consist of 70% clean, coarse, sharp, Lake Wales Silica Sand (alternate: Ortona or FDOT #3 coarse silica sand) and 30% Everglades muck mixed with the excavated Native Soil in a 1:1 ratio. Excavated Native Soil shall be natural, friable, and free from rocks larger than 1/2" diameter, weeds, stumps, plant tissue, litter, toxic substances, or any other deleterious materials, and approved for use by the Landscape Architect prior to plant installation. All soil shall be delivered in a loose friable condition.

**PART 3 - EXECUTION**

**3.1 EQUIPMENT & MEANS**

A. Relocation operations shall be conducted with any equipment and by the means suitable for the intended task, so long as the safety and health of vegetation to be relocated is assured.

**3.2 ROADBED PROTECTION**

A. Relocation operations shall be conducted with any equipment and by any means suitable for the intended task, so long as the safety and health of vegetation to be relocated is assured.

**3.3 VEGETATION**

A. Any permit costs associated with the relocation of vegetation shall be borne by the Contractor.

**3.4 ON-SITE TREE AND PALM HOLDING AREA**

A. All Trees and Palms designated for transplanting on-site shall be first planted at the on-site Holding Area if designated on the plans.

B. Prior to moving plants into the Holding Area, if required by the plans, the Contractor shall install a fully-functional temporary irrigation system, that will provide full water coverage of the entire Holding Area on a daily basis as required.

**3.5 LOCATING RELOCATED PLANTS**

A. The final location of all transplanted material is shown on the plans. Should a conflict arise with the general location as shown by the drawings, revisions to the final plant locations shall be approved by the Landscape Architect.

## 3.6 PRUNING

A. Prune only dead or severely injured branches or roots under direction of the Landscape Architect or Project Arborist. All pruning of roots and branches shall follow good horticultural practices to preserve natural character of plant. Pruning shall be done with clean sharp tools. Do not prune to compensate for root loss. Do not paint wounds. Trees should be pruned following the ANSI A-300 pruning standards.

B. Root Pruning:

1. All trees and palms shall be root pruned per current horticultural best practices as follows unless otherwise specified on the transplanting schedule.

2. All trees with a diameter at breast height (DBH) less than 18" in diameter to be transplanted shall be root pruned at least forty -five (45) days prior to actual relocation.

3. All trees with a DBH greater than 18" in diameter to be transplanted shall be root pruned at least ninety (90) days prior to relocation on two opposing sides (i.e. north-south) and 45 days later on the two remaining sides.

4. All palms shall be root pruned at least fourteen (14) days prior to relocations.

## 3.7 TRANSPLANTING SEQUENCE

A. In order to minimize conflicts in the execution of work, the contractor shall follow the planting sequence as shown below, after designation of plants to be relocated.

1. Prior to site preparation, the Contractor shall request approval of these final locations from the Landscape Architect.

2. Once the site is approved, the Contractor shall prepare the site for tree relocation per the plans and details.

3. Transplant trees and palms to locations shown on the drawings as required by these specifications, and erect a tree protection fence as shown on the details.

4.. Maintain the transplanted trees per the planting specifications.

## 3.8 WATERING

A. Water shall be furnished upon the relocation of trees and palms. Apply water to completely soak the planting pit on a daily basis for two (2) weeks. Thereeafter, apply water to completely soak the planting pit each two days for the following four (4) weeks, and if signs of root establishment are evident according to the Landscape Architect or Project Arborist, reduce the watering to every three (3) days until project acceptance.

**3.9 GUYING & STAKING**

A. All trees and palms shall be staked as shown in the drawings.

**3.10 FERTILIZER**

A. Apply granular 'Palm Special' 8-2-12, or approved equal, at manufacturer's recommended rate following the first flush of new growth, or otherwise approved by the Landscape Architect.

**END OF SECTION**

# SECTION 333000 – Sanitary Sewerage

## PART 1 - GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A48 (2003; R2012) | Standard Specification for Gray Iron Castings |
| ASTM A536 (1984; R2014) | Standard Specification for Ductile Iron Castings |
| ASTM C33 (2018) | Standard Specification for Concrete Aggregates |
| ASTM C76 (2019) | Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe |
| ASTM C150 (2018) | Standard Specification for Portland Cement |
| ASTM C443 (2020) | Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets |
| ASTM D1784 (2020) | Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |
| ASTM D3034 (2016) | Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |

### 1.2 SUBMIITALS

1. Preconstruction Submittals

   The Contractor prior to construction shall submit records of Existing Conditions.

2. Shop drawings

   a. Installation Drawings

3. Product Data

   a. Precast Concrete Manholes
   b. Frames, Covers, and Gratings
   c. Gravity Pipe

4. As-Built Drawings

As-Built Drawings for the complete sanitary sewer system shall be submitted showing complete detail with all dimensions, both above and below grade.

## PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement Mortar

Provide cement mortar conforming to ASTM C270, Type M with Type II cement.

B. Concrete Aggregates

Aggregates shall conform to ASTM C33.

C. Rubber Gaskets

Rubber gaskets shall conform to ASTM C443.

D. Pipe

Pipe shall be as follows:

1. Polyvinylchloride (PVC) pipe and fittings shall conform to ASTM D3034
2. Cells shall conform to ASTM D1784 class 12454-B.

E. Portland Cement

Portland cement shall conform to ASTM C150.

F. Frames, Covers and Gratings

Frame and cover are to be cast gray iron, ASTM A48, Class 35B or cast ductile iron, ASTM A536, Grade 65-45-12.

G. Jointing

Cement mortar shall not be used as a pipe-jointing material except for wye branches. Pipe joints shall be sealed with:

1. Factory molded plastic in the annular space and on the spigot of the pipe.
2. A rubber gasket configuration, as recommended by the pipe manufacturer for the particular type of pipe joint. Gaskets shall be installed to provide a tight fit. Rubber gaskets may be used with clay pipe, concrete pipe, cast iron soil pipe, PVC pipe, and ABS pipe.

H. Manholes

1. Construction

Manholes shall be constructed of brick, concrete, reinforced precast-concrete rings, precast-concrete rings, or precast-concrete segmental blocks, with cast iron frames and covers. Frames and covers

shall be bolted down and as necessary. Frames and covers shall be set so that the top of the cover is 4-inches higher than finished grade, where no pavement exists. Where pavement does exist, frames shall be flush with surface. Invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.

2. Invert Channels

Invert channels shall be built up with brick and mortar. Flooring of the manhole outside the channels shall be smooth and shall slope toward the channels, no less than 1 inch per foot nor more than 2 inches per foot. The free drop inside the manholes shall not exceed 1 foot 6 inches measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels. Drop manholes shall be constructed whenever the free drop would be greater than 1 foot 6 inches.

3. Concrete

Concrete used in manholes shall have a compressive strength of not less than 3,000 pounds per square inch after 28 days and shall be composed of not less than six 7-1/2 bags of Portland Cement per cubic yard. Coarse aggregate shall be used in the greatest amount consistent with required workability. The foregoing requirements apply to concrete in precast rings, segmental blocks, and concrete poured in place. Concrete rings shall conform to ASTM C76, except that the length of sections may be shorter as conditions require. Wall thickness shall be not less than 4 inches and shall be reinforced with No. 4 at 12-inch on center. each way. Joints between precast rings shall be full bedded in cement mortar and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Segmental blocks shall be at least 5 inches but not more than 8 inches in thickness, not less than 8 inches in length, and of a shape that the joints can be effectively sealed and bonded with cement mortar.

4. Jointing and Plastering

Mortar for jointing and plastering shall consist of 1 part Portland Cement and 2 parts fine sand with enough water to produce a workable consistency. For brickwork, lime may be added to the mortar in the amount of not more than 25 percent of the volume of cement. Joints shall be completely filled, smooth, and free from surplus mortar on the inside of the manhole. Brick manholes shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. Brick shall be laid radically with every sixth course laid as a stretcher course.

## PART 3 - EXECUTION

### 3.1 LOCATION

Where the location of the sewer is not clearly defined by dimensions, the sewer shall be laid not closer than 10 feet horizontally to a water supply main or service line, except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing shall be a minimum of 6 feet. Water lines shall be above sewage force mains. Where gravity-flow sewers cross above waterlines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be cast iron, steel, or other acceptable pressure pipe and without joints closer horizontally than 3 feet to the crossing, or the sewer pipe shall be fully encased in concrete. Thickness of the concrete, including that at the pipe joints, shall be not less than 4 inches.

## 3.2 PIPE LAYING

Bottom of trench shall be shaped to give uniform circumferential support to the lower fourth of each pipe. Pipe laying shall precede upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid true to line and grade in a manner to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. Interior of the sewer shall be cleared of superfluous materials at all times. Where cleaning after laying is difficult, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. When the maximum width of the trench at the top of the pipe is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Owner, such bedding as may be required to satisfactorily support the added load of the backfill. Trenches shall be kept free from water until the pipe-joining material has set. Pipe shall not be laid when the condition of the trench or the weather is unsuitable for such work. When work is not in progress, open ends of pipe and fittings shall be closed to prevent intrusion of foreign materials.

## 3.3 INFILTRATION AND EXFILTRATION

Leakage shall not exceed a rate of 200 gallons per inch of pipe diameter per mile per day of sewer for any section between successive manholes. When infiltration appears excessive, a suitable weir or other device shall measure the amount of leakage. When the determination of infiltration is not practicable because of dry trench conditions, exfiltration tests shall be made by filling the sewer between successive manholes with water to the top of the outlet of the upper manholes. Amount of water required to maintain the pipe full for the required test period shall be measured and the rate of leakage determined. When leakage exceeds the maximum amount, an approved correction shall be made. Both measurement and correction shall be made at no additional cost to the Owner

## 3.4 WYE BRANCHES

Commercially manufactured wye branches shall be installed where sewer connections are necessary. Cutting into pipe for connections shall not be done except as approved. When conditions are such that the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete or supported on a concrete cradle as directed. Concrete required due to faulty construction methods or negligence of the Contractor shall be installed at no additional cost to the Owner.

## 3.5 CONNECTIONS TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made in such manner that the finished work shall conform as nearly as practicable to the applicable requirements for new manholes.

## 3.6 ACCEPTANCE

Sections of the sewer found defective in material, alignment, grade, or joints shall be corrected at no additional cost to the Owner before acceptance.

END OF SECTION

**SECTION 334000 - STORMWATER**
**(R-TANK SYSTEM)**

## PART 1 – GENERAL

1.01 Related Documents

A. Drawings, technical specification and general provisions of the Contract as modified herein apply to this section.

1.02 Description of Work Included

A. Provide excavation and base preparation per geotechnical engineer's recommendations and/or as shown on the design drawings, to provide adequate support for project design loads and safety from excavation sidewall collapse. Excavations shall be in accordance with the owner's and OSHA requirements.

B. Provide and install R-Tank$^{LD}$, R-Tank$^{HD}$, R-Tank$^{SD}$, or R-Tank$^{UD}$ system (hereafter called R-Tank) and all related products including fill materials, geotextiles, geogrids, inlet and outlet pipe with connections per the manufacturer's installation guidelines provided in this section.

C. Provide and construct the cover of the R-Tank system including; stone backfill, structural fill cover, and pavement section as specified.

D. Protect R-Tank system from construction traffic after installation until completion of all construction activity in the installation area.

1.03 Quality Control

A. All materials shall be manufactured in ISO certified facilities.

B. Installation Contractor shall demonstrate the following experience:

1. A minimum of three R-Tank or equivalent projects completed within 2 years; and,

2. A minimum of 25,000 cubic feet of storage volume completed within 2 years.

3. Contractor experience requirement may be waived if the manufacturer's representative provides on-site training and review during construction.

C. Installation Personnel: Performed only by skilled workers with satisfactory record of performance on bulk earthworks, pipe, chamber, or pond/landfill construction projects of comparable size and quality.

D. Contractor must have manufacturer's representative available for site review if requested by Owner.

1.04 Submittals

A. Submit proposed R-Tank layout drawings. Drawings shall include typical section details as well as the required base elevation of stone and tanks, minimum cover requirements and tank configuration.

B. Submit manufacturer's product data, including compressive strength and unit weight.

C. Submit manufacturer’s installation instructions.

D. Submit R-Tank sample for review. Reviewed and accepted samples will be returned to the Contractor.

E. Submit material certificates for geotextile, geogrid, base course and backfill materials.

F. Submit required experience and personnel requirements as specified in Section 1.03.

G. Any proposed equal alternative product substitution to this specification must be submitted for review and approved prior to bid opening. Review package should include third party reviewed performance data that meets or exceeds criteria in Table 2.01 B.

1.05 Delivery, Storage, and Handling

A. Protect R-Tank and other materials from damage during delivery, and store UV sensitive materials under tarp to protect from sunlight when time from delivery to installation exceeds two weeks. Storage of materials should be on smooth surfaces, free from dirt, mud and debris.

B. Handling is to be performed with equipment appropriate to the materials and site conditions, and may include hand, handcart, forklifts, extension lifts, etc.

C. Cold weather:

1. Care must be taken when handling plastics when air temperature is 40 degrees or below as plastic becomes brittle.

2. Do not use frozen materials or materials mixed or coated with ice or frost.

3. Do not build on frozen ground or wet, saturated or muddy subgrade.

1.06 Preinstallation Conference.

A. Prior to the start of the installation, a preinstallation conference shall occur with the representatives from the design team, the general contractor, the excavation contractor, the R-Tank installation

contractor, and the manufacturer's representative.

1.07 Project Conditions

A. Coordinate installation for the R-Tank system with other on-site activities to eliminate all non-installation related construction traffic over the completed R-Tank system. No loads heavier than the design loads shall be allowed over the system, and in no case shall loads higher than a standard AASHTO HS20 (or HS25, depending on design criteria) load be allowed on the system at any time.

B. Protect adjacent work from damage during R-Tank system installation.

C. All pre-treatment systems to remove debris and heavy sediments must be in place and functional prior to operation of the R-Tank system. Additional pretreatment measures may be needed if unit is operational during construction due to increased sediment loads.

D. Contractor is responsible for any damage to the system during construction.

## PART 2 – PRODUCTS

2.01 R-Tank Units

A. R -Tank - Injection molded plastic tank plates assembled to form a 95% void modular structure of predesigned height (custom for each project).

| PROPERTY | DESCRIPTION | R-Tank$^{LD}$ VALUE | R-Tank$^{HD}$ VALUE | R-Tank$^{SD}$ VALUE | R-Tank$^{UD}$ VALUE |
|---|---|---|---|---|---|
| Void Area | Volume available for water storage | 95% | 95% | 95% | 95% |
| Surface Void Area | Percentage of exterior available for infiltration | 90% | 90% | 90% | 90% |
| Compressive Strength | ASTM D 2412 / ASTM F 2418 | 30.0 psi | 33.4 psi | 42.9 psi | 134.2 psi |
| HS-20 Minimum Cover | Cover required to support HS-20 loads | N/A | 20” | 18” | 12” (Stone Backfill) |
| HS-25 Minimum Cover | Cover required to support HS-25 loads | N/A | 24” | 19” | 15” (Stone Backfill) |
| Maximum Cover | Maximum allowable cover depth | 3 feet | < 7 feet | < 10 feet | 5 feet |
| Unit Weight | Weight of plastic per cubic foot of tank | 3.29 lbs / cf | 3.62 lbs/cf | 3.96 lbs / cf | 4.33 lbs / cf |

| | | | | | |
|---|---|---|---|---|---|
| Rib Thickness | Thickness of load-bearing members | 0.18 inches | 0.18 inches | 0.18 inches | N/A |
| Service Temperature | Safe temperature range for use | -14 – 167° F | -14 – 167° F | -14 – 167° F | -14 – 167° F |

B. R-Tank units shall meet the following Physical & Chemical Characteristics:

C. Supplier: ACF Environmental 2831 Cardwell Road Richmond, VA 23234
(T): 800-448-3636; (F): 804-743-7779 www.acfenvironmental.com

2.02 Geosynthetics

A. Geotextile. A geotextile envelope is required to prevent backfill material from entering the R-Tank modules.

1. **Standard Application**: The standard geotextile shall be an 8 oz per square yard nonwoven geotextile (ACF N080 or equivalent).

2. **Infiltration Applications**: When water must infiltrate/exfiltrate through the geotextile as a function of the system design, a woven monofilament (ACF M200 or equivalent) shall be used.

B. Geogrid. For installations subject to traffic loads and/or when required by project plans, install geogrid (ACF BX12 or equivalent) to reinforce backfill above the R-Tank system. Geogrid is not always required for R-Tank$^{UD}$ installations, and is often not required for non-traffic load applications.

2.03 Backfill & Cover Materials

A. **Bedding Materials:** Stone (angular and smaller than 1.5” in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System) shall be used below the R-Tank system (3” minimum). Material must be free from lumps, debris, and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation. For infiltration applications bedding material shall be free draining.

B. **Side and Top Backfill**: Material must be free from lumps, debris and any sharp objects that could cut the geotextile. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

1. Traffic Applications - Free draining material shall be used adjacent to (24” minimum) and above (for the first 12”) the R-Tank system.
   a. For HD, and SD modules, backfill materials shall be free draining stone (angular and smaller than 1.5” in diameter) or soil (GW, GP, SW, or SP as classified by the Unified Soil Classification System).

b. For UD modules with less than 14" of top cover, backfill materials shall be free draining stone (angular and smaller than 1.5" in diameter). The use of soil backfill on the sides and top of the UD module is not permitted unless the modules are installed outside of traffic areas or with cover depths of 14" or more. Top backfill material (from top of module to bottom of pavement base or 12" maximum) must be consistent with side backfill.

2. Non-Traffic / Green Space Applications - For all R-Tank modules installed in green spaces and not subjected to vehicular loads, backfill materials may either follow the guidelines for Traffic Applications above, or the top backfill layer (12" minimum) may consist of AASHTO #57 stone blended with 30-40% (by volume) topsoil to aid in establishing vegetation.

C. **Additional Cover Materials**: Structural Fill shall consist of granular materials meeting the gradational requirements of SM, SP, SW, GM, GP or GW as classified by the Unified Soil Classification System. Structural fill shall have a maximum of 25 percent passing the No. 200 sieve, shall have a maximum clay content of 10 percent and a maximum Plasticity Index of 4. Material shall be within 3 percent of the optimum moisture content as determined by ASTM D698 at the time of installation.

2.04 Other Materials

A. Utility Marker: Install metallic tape at corners of R-Tank system to mark the area for future utility detection.

## PART 3 - EXECUTION

3.01 Assembly of R-Tank Units

A. Assembly of modules shall be performed in accordance with the R-Tank Installation Manual, Section 2.

3.02 Layout and Excavation

A. Installer shall stake out, excavate, and prepare the subgrade area to the required plan grades and dimensions, ensuring that the excavation is at least 2 feet greater than R-Tank dimensions in each direction allowing for installation of geotextile filter fabric, R-Tank modules, and free draining backfill materials.

B. All excavations must be prepared with OSHA approved excavated sides and sufficient working space.

C. Protect partially completed installation against damage from other construction traffic by establishing a perimeter with high visibility construction tape, fencing, barricades, or other means until construction is complete.

D. Base of the excavation shall be uniform, level, and free of lumps or debris and soft or yielding subgrade areas. A minimum 2,000 pounds per square foot bearing capacity is required.

1. **Standard Applications**: Compact subgrade to a minimum of 95% of Standard Proctor (ASTM D698) density or as required by the Owner's engineer.

2. **Infiltration Applications**: Subgrade shall be prepared in accordance with the contract documents. Compaction of subgrade should not be performed in infiltration applications.

E. **Unsuitable Soils or Conditions**: All questions about the base of the excavation shall be directed to the owner's engineer, who will approve the subgrade conditions prior to placement of stone. The owner's engineer shall determine the required bearing capacity of the R-Tank subgrade; however in no case shall a bearing capacity of less than 2,000 pounds per square foot be provided.

1. If unsuitable soils are encountered at the subgrade, or if the subgrade is pumping or appears excessively soft, repair the area in accordance with contract documents and/or as directed by the owner's engineer.

2. If indications of the water table are observed during excavation, the engineer shall be contacted to provide recommendations.

3. Do not start installation of the R-Tank system until unsatisfactory subgrade conditions are corrected and the subgrade conditions are accepted by the owner's engineer.

3.03 Preparation of Base

A. Place a thin layer (3" unless otherwise specified) of bedding material (Section 2.03 A), over the subgrade to establish a level working platform for the R-Tank modules. Level to within ½" (+/- ¼") or as shown on the plans. Native subgrade soils or other materials may be used if determined to meet the requirements of 2.03 A and are accepted by the owner's engineer.

1. **Standard Applications**: Static roll or otherwise compact bedding materials until they are firm and unyielding.

2. **Infiltration Applications**: Bedding materials shall be prepared in accordance with the contract documents.

B. Outline the footprint of the R-Tank system on the excavation floor using spray paint or chalk line to ensure a 2' perimeter is available around the R-Tank system for proper installation and compaction of backfill.

3.04 Installation of the R-Tanks

A. Where a geotextile wrap is specified on the stone base, cut strips to length and install in excavation,

removing wrinkles so material lays flat. Overlap geotextile a minimum 12” or as recommended by manufacturer.

B. Where an impervious liner (for containment) is specified, install the liner per manufacturer’s recommendations and the contract documents. The R-Tank units shall be separated from impervious liner by a non-woven geotextile fabric installed accordance with Section 3.04A.

C. Install R-Tank modules by placing side by side, in accordance with the design drawings. No lateral connections are required. It is advisable to use a string line to form square corners and straight edges along the perimeter of the R-Tank system. The modules are to be oriented as per the design drawing with required depth as shown on plans..

1. For LD, HD, and SD installations, the large side plate of the tank should be placed on the perimeter of the system. This will typically require that the two ends of the tank area will have a row of tanks placed perpendicular to all other tanks. If this is not shown in the construction drawings, it is a simple field adjustment that will have minimal effect on the overall system footprint. Refer to R-Tank Installation Guide for more details

2. For UD installations, there is no perpendicular end row required.

D. Wrap the R-Tank top and sides in specified geotextile. Cut strips of geotextile so that it will cover the sides and top, encapsulating the entire system to prevent backfill entry into the system. Overlap geotextile 12” or as recommended by manufacturer. Take great care to avoid damage to geotextile (and, if specified, impervious liner) during placement.

E. Identify locations of inlet, outlet and any other penetrations of the geotextile (and optional liner). These connections should be installed flush (butted up to the R-Tank) and the geotextile fabric shall be cut to enable hydraulic continuity between the connections and the R-Tank units. These connections shall be secured using pipe boots with stainless steel pipe clamps. Support pipe in trenches during backfill operations to prevent pipe from settling and damaging the geotextile, impervious liner (if specified) or pipe. Connecting pipes at 90 degree angles facilitates construction, unless otherwise specified. Ensure end of pipe is installed snug against R-Tank system.

F. Install Inspection and Maintenance Ports in locations noted on plans. At a minimum one maintenance port shall be installed within 10’ of each inlet & outlet connection, and with a maximum spacing of one maintenance port for every 2,500 square feet. Install all ports as noted in the R-Tank Installation Guide.

G. If required, install ventilation pipes and vents as specified on drawings to provide ventilation for proper hydraulic performance. The number of pipes and vents will depend on the size of the system. Vents are often installed using a 90 degree elbow with PVC pipe into a landscaped area with ‘U” bend or venting bollard to inhibit the ingress of debris. A ground level concrete or steel cover can be used.

3.05 Backfilling of the R-Tank Units

A. Backfill and fill with recommended materials as follows:

1. Place freely draining backfill materials (Section 2.03 B) around the perimeter in lifts with a maximum thickness of 12". Each lift shall be placed around the entire perimeter such that each lift is no more than 24" higher than the side backfill along any other location on the perimeter of the R-Tank system. No fill shall be placed over top of tanks until the side backfill has been completed.

2. Each lift shall be compacted at the specified moisture content to a minimum of 95% of the Standard Proctor Density until no further densification is observed (for self-compacting stone materials). The side lifts must be compacted with walk behind compaction equipment. Even when "self-compacting" backfill materials are selected, a walk behind vibratory compactor must be used.

3. Take care to ensure that the compaction process does not allow the machinery to come into contact with the modules due to the potential for damage to the geotextile and R-Tank units.

4. No compaction equipment is permissible to operate directly on the R-Tank modules.

5. Top Backfill:

    a. Typical Applications: Install a 12" (or as shown on plans) lift of freely draining material (Section 2.03 B) over the R-Tank Units, maintaining 12" between equipment tracks and R-Tank System.

    b. Shallow Applications (< 18" total cover): Install top backfill in accordance with plans.

    Lightly compacted using a walk-behind trench roller. Alternately, a roller (maximum gross vehicle weight of 6 tons) may be used. Roller must remain in static mode until a minimum of 24" of cover has been placed over the modules. Sheep foot rollers should not be used.

6. If required, install a geogrid as shown on plans. Geogrid shall extend a minimum of 3 feet beyond the limits of the excavation wall.

7. Following placement and compaction of the initial cover, subsequent lifts of structural fill (Section 2.03 C) shall be placed at the specified moisture content and compacted to a minimum of 95% of the Standard Proctor Density and shall cover the entire footprint of the R-Tank system. During placement of fill above the system, unless otherwise specified, a uniform elevation of fill shall be maintained to within 12" across the footprint of the R-Tank system. Do not exceed maximum cover depths listed in Table 2.01 B.

8. Place additional layers of geotextile and/or geogrid at elevations as specified in the design details. Each layer of geosynthetic reinforcement placed above the R-Tank system shall extend a minimum of 3 feet beyond the limits of the excavation wall.

B. Only low pressure tire or track vehicles shall be operated over the R-Tank system during construction. No machinery should drive on top of the tank until a minimum of 18" of backfill and compaction is achieved. Dump Trucks and Pans shall not be operated within the R-Tank system

footprint at any time. Where necessary the heavy equipment should unload in an area adjacent to the R-Tank system and the material should be moved over the system with tracked equipment.

C. Ensure that all unrelated construction traffic is kept away from the limits of excavation until the project is complete and final surface materials are in place. No non-installation related loading should be allowed over the R-Tank system until the final design section has been constructed (including pavement).

D. Place surfacing materials, such as groundcovers (no large trees), or paving materials over the structure with care to avoid displacement of cover fill and damage to surrounding areas.

E. Backfill depth over R-Tank system must be within the limitations shown in the table in Section 2.01 B. If the total backfill depth does not comply with this table, contact engineer or manufacturer's representative for assistance.

## PART 4 – USING THE SYSTEM

4.01 Maintenance Requirements

A. A routine maintenance effort is required to ensure proper performance of the R-Tank system. The Maintenance program should be focused on pretreatment systems. Ensuring these structures are clean and functioning properly will reduce the risk of contamination of the R-Tank system and stormwater released from the site. Pre-treatment systems shall be inspected yearly, or as directed by the regulatory agency and by the manufacturer (for proprietary systems). Maintain as needed using acceptable practices or following manufacturer's guidelines (for proprietary systems).

B. Inspection and/or Maintenance Ports in the R-Tank system will need to be inspected for accumulation of sediments at least quarterly through the first year of operation and at least yearly thereafter. This is done by removing the cap of the port and using a measuring device long enough to reach the bottom of the R-Tank system and stiff enough to push through the loose sediments, allowing a depth measurement.

C. If sediment has accumulated to the level noted in the R-Tank Maintenance Guide or beyond a level acceptable to the Owner's engineer, the R-Tank system should be flushed.

D. A flushing event consists of pumping water into the Maintenance Port and/or adjacent structure, allowing the turbulent flows through the R-Tank system to re-suspend the fine sediments. If multiple Maintenance Ports have been installed, water should be pumped into each port to maximize flushing efficiency. Sediment-laden water can be filtered through a Dirtbag™ or approved equivalent if permitted by the locality.

**END OF SECTION**

# SECTION 334000 – STORMWATER UTILITIES

## PART 1 - GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO M252 (2018) | Standard Specification for Corrugated Polyethylene Drainage Pipe |
| AASHTO M288 (2017) | Standard Specification for Geosynthetic Specification for Highway Applications |
| AASHTO M330 (2019) | Standard Specification for Polypropylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A48 (2003; R2012) | Standard Specification for Gray Iron Castings |
| ASTM A849 (2015) | Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe e and High Strength Mortar |
| ASTM C32 (2013; R 2017) | Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale) |
| ASTM C139 (2017) | Standard Specification for Concrete Masonry Units for Con |
| ASTM C270 (2019) | Standard Specification for Mortar for Unit Masonry |
| ASTM C387 (2017) | Standard Specification for Packaged, Dry, Combined Materials for Concrete |
| ASTM C478 (2018) | Standard Specification for Circular Precast Reinforced Concrete Manhole Sections |
| ASTM C443 (2020) | Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets |
| ASTM C923 (2008; R 2013; E 2016) | Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals |

| | |
|---|---|
| ASTM D2855 (2015) | 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 |
| ASTM D2321 (2018) | Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications |
| ASTM D3034 (2016) | Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| ASTM D3212 (2007; R 2020) | Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM F477 (2014) | Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F794 (2003; R 2014) | Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter |
| ASTM F1417 (2011a; R 2019) | Standard Practice for Installation Acceptance of Plastic Non-pressure Sewer Lines Using Low-Pressure Air |
| ASTM F2487 (2017) | Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Corrugated High Density Polyethylene and Polypropylene Pipelines |
| ASTM F2881 (2019) | Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications |
| ASTM F3219 (2019) | Standard Specification for 3 to 30 in. (75 To 750 mm) Polypropylene (PP) Corrugated Single Wall Pipe and Fittings |

AMERICAN WATER WORKS ASSOCIATION

| | |
|---|---|
| AWWA C210 (2007) | Liquid-Epoxy Coating Systems for The Interior and Exterior Of Steel Water Pipelines |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS RR-F-621 (Rev E) | Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole |

1.2 SUBMIITALS

1. Product Data

Manufacturer's catalog data shall be submitted for the following:

a. Concrete Mortar
b. Brick Mortar
c. Gaskets
d. Compression Joints
e. Frames, Covers and Gratings
f. Precast Concrete Manholes
g. Precast Concrete Base Sections
h. Concrete Block
i. Brick
j. Bituminous Coating
k. Cold Bituminous Mastic Sealer

2. Test Reports

a. Infiltration Test
b. Exfiltration Test
c. Hydrostatic Test

1.3 BEDDING AND BACKFILL

Bedding and backfill shall be in accordance with the latest edition of the Florida Department of Transportation, Standard Specifications for Road and Bridge Construction.

**PART 2 - PRODUCTS**

2.1 BONDING AND SEALING MATERIALS

A. Bituminous Coating and Sealing

1. Coating shall be in accordance with ASTM A849.
2. Coating shall be in accordance with ASTM A849, when using materials previously coal-tar coated and for each uncoated ferrous piece used underground.
3. Cold Bituminous Mastic Sealer shall be in accordance with ASTM A849 trowel consistency.

B. Epoxy Bonding

Epoxy adhesive shall be in accordance with AWWA C210.

2.2 FILTER MATERIAL

A. Filter Fabric

Fabric shall be in accordance with AASHTO M288, and be water pervious, made of polyester materials.

B. Filter Aggregate

Aggregate shall be clean gravel free from organic materials, clay, or other deleterious materials, graded to the following minimal limits:

| Sieve Size | Percent Passing |
|---|---|
| No. 4 | 15 to 30 |

2.3 MANHOLE AND CATCH-BASIN MATERIALS

Water, for use with concrete block and brick, shall be clean and potable.

A. Concrete Block and Mortar

1. Concrete block shall be in accordance with ASTM C139.
2. Concrete Mortar shall be in accordance with ASTM C387, Type M or ASTM C270, Type S.

B. Brick and Mortar

1. Brick shall conform to ASTM C32, Grade MS.
2. Brick Mortar shall conform to ASTM C270, Type M.

2.4 CONDUIT PIPING, JOINTS, FITTINGS AND GASKETS

A. Corrugated Plastic Piping

1. Pipe and Fittings

Corrugated, high-density polyethylene pipe (HDPE) N12 conforming to AASHTO M252.

a. Joints and Jointing Materials

Manufacturer's recommendations for HDPE joints.

2. HP Storm Pipe

a. 12- through 30-inch (300 to 750 mm) pipe shall have a smooth interior and annular exterior corrugations and meet or exceed ASTM F3219 and AASHTO M330
b. 36- through 60-inch (900 to 1500 mm) pipe shall have a smooth interior and annular exterior corrugations and meet or exceed ASTM F2881 and AASHTO M330
c. Manning’s “n” value for use in design shall be 0.012.

3. Joint Performance

a. Pipe shall be joined with a gasketed integral bell & spigot joint meeting the requirements of ASTM F3219 or F2881, for the respective diameters.
b. 12- through 60-inch shall be watertight according to the requirements of ASTM D3212. Spigots shall have gaskets meeting the requirements of ASTM F477. Gasket shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.

c. 12- through 60-inch diameters shall have a reinforced bell with a polymer composite band installed by the manufacturer.

4. Fittings

a. Fittings shall conform to ASTM F3219, ASTM F2881 and AASHTO M330, for the respective diameters. Bell & spigot connections shall utilize a spun-on, welded or integral bell and spigot with gaskets meeting ASTM F477. Bell & spigot fittings joint shall meet the watertight joint performance requirements of ASTM D3212.
b. Corrugated couplings shall be split collar, engaging at least 2 full corrugations.

5. Field Pipe and Joint Performance

To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

6. Material Properties

Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F3219, Section 4, ASTM F2881, Section 5 and AASHTO M330, Section 6.1, for the respective diameters.

7. Installation

Installation shall be in accordance with ASTM D2321 and manufacturer recommended installation guidelines, with the exception that minimum cover in traffic areas for 12- through 48-inch diameters shall be one foot and for 60-inch diameters, the minimum cover shall be 2 ft. in single run applications. Backfill for minimum cover situations shall consist of Class 1, Class 2 (minimum 90% SPD) or Class 3 (minimum 95%) material. Maximum fill heights depend on embedment material and compaction level.

B. Type PSM Poly (Vinyl Chloride) (PVC) Pipe

a. Pipe shall be in accordance with ASTM D3034, SDR 35, up to 15-inch diameter.
b. Pipe ends made for joints shall be solvent cement type.
c. PSM PVC Pipe, 18 to 48 inch diameter shall be in accordance with ASTM F794.

1. PVC Pipe Joints

a. Joints shall be in accordance with ASTM D3212, push-on type.
b. solvent cement shall be in accordance with ASTM D2855.

## 2.5 FRAMES, COVERS AND GRATINGS

Manhole, catch basin, and sump frames, covers, and gratings shall be in accordance with FS RR-F-621.

1. Cast iron materials shall be provided.
2. The following legends shall be cast-in on every cover: STORM SEWER.
3. Cast iron shall conform to ASTM A48, Class 30B, minimum.

A. Manhole Ring and Cover

1. Ring and Cover shall be, USF 310-A.

B. Catch-Basin Frames and Gratings

1. Frames and Grating shall be USF 4105-6224

2.6 PRECAST CONCRETE MANHOLES, RISERS AND PRECAST CONCRETE BASE SECTIONS

1. Concrete manholes, risers, base sections, and tops shall be pre-cast and conform to ASTM C478.
2. Precast parts shall contain reinforcing bars.

A. Manhole Gaskets

Gaskets shall be in accordance with ASTM C443 for joints between manhole sections.

B. Manhole Connectors

Connectors shall be in accordance with ASTM C923 for joints between manhole and pipes.

**PART 3 - EXECUTION**

3.1 EXCAVATION AND BACKFILL

Excavation, backfill, and removal of unsatisfactory materials shall be in accordance with the latest edition of the Florida Department of Transportation, Standard Specifications for Road and Bridge Construction.

3.2 GRADING

Grading shall be performed in accordance with the Site Civil grading plans and specifications.

3.3 PIPE INSTALLATION

A. Pipe Installation

1. Excavations shall be trimmed to required elevations. Objects that impair backfilling or compaction shall be removed. Over-excavation shall be corrected with fill material.
2. Pipe and fittings shall be inspected for defects before installing. Defective materials shall be removed from site.
3. Pipe interior shall be cleaned before installation. Pipe ends shall be sealed when work is not in progress.
4. Pipe shall be laid to line and grade, with bell end upstream.
5. Maximum variation from true slope shall not exceed 1/8 inch in 10 feet.
6. Maximum deviation from design elevation shall not exceed 0.04 feet at any point in the system.

7. Maximum deviation from true line shall not exceed 0.20 feet for pipe 15 inches in diameter and smaller, 0.40 feet for pipe larger than 15 inches in diameter.
8. Corrections shall be made at a rate not to exceed 0.10 foot for one length of conduit.

B. Installation of Corrugated Plastic Piping

Install pipe and fittings in accordance with the recommendations of the HDPE pipe manufacturer.

C. PVC Plastic Pipe Installation

PVC pipe and fittings shall be installed in accordance with manufacturer's instructions and in accordance with ASTM D2321.

## 3.4 PIPE BEDDING

A. Bedding

1. Minimum compacted bedding under installed pipe shall be one-fourth of the pipe diameter in thickness, and in no case less than 4 inches or more than 12 inches.
2. Bedding shall be placed in layers not exceeding 6 inches in depth and compacted. Additional layers shall be added until a minimum elevation of 12 inches above the pipe is achieved.

B. Trench Pipe Cradle

Trench pipe cradle shall be constructed monolithically of 3000-psi, air-entrained concrete.

C. Concrete Encasement

Pipe shall be encased in 3000-psi air-entrained concrete to a level of not less than 6-inches above the top of pipe.

D. Compaction

Puddling or jetting shall not be permitted when compacting bedding materials.

## 3.5 UNDERGROUND STRUCTURES

A. Structures

1. 1/2-inch thick ASTM C387, Type M mortar shall be applied to both interior and exterior surfaces.
2. Top of manhole and catch basin covers shall be set flush with finished pavement surfaces. Elsewhere, tops shall be set 3-inches above finished surface.
3. Preformed bituminous expansion joint material shall be provided 3/4-inch thickness around drainage structures in pavements.
4. Joints for concrete risers and tops shall be bedded in mortar and smoothed to uniform surface on both interior and exterior of structure.
5. Catch basins and curb drop inlets shall be constructed.

B. Invert Channel Installation

Invert channels shall be smooth and fitted to each inlet, outlet, or transition for correct hydraulic flow.

## 3.6 STORM SEWER CONNECTIONS AND WYES

1. Pipe connections to existing conduit and manholes shall be provided.
2. Wyes for branch connections shall be provided. Field cutting into conduit shall not be permitted. Wyes shall be sprung into existing lines. Entire wye shall be encased in concrete.
3. Epoxy shall be used to secure each interface connecting new and existing conduit.

## 3.7 FIELD QUALITY CONTROL

A. Tests

Contractor shall provide test equipment or engage the services of a firm to provide the necessary testing.

1. Hydrostatic Test on Watertight Joints

   a. Hydrostatic tests shall be upon one sample for each type of joint to be installed. When the sample joint fails, an additional joint of the same type shall be re-tested.
   b. Joints shall be protected from temperatures, which adversely affect the joining materials.
   c. Test results for concrete pipe shall conform to ASTM C443.
   d. Hydrostatic Pressure tests shall be performed at a pressure of 10 pounds per square inch (psi) for 24 hours. When test is completed test sections shall be angled and retested at 10-psi for an additional 24 hours.

2. Low Pressure Air Test of Conduit

Acceptance tests for installed ferrous and plastic piping shall be in accordance with ASTM F1417.

B. Interior Inspection of Pipe

Installed pipe shall be inspected when 2-feet of earth cover is in place and upon completion of project. The Contractor at no additional cost to the Owner shall correct displaced or misaligned pipe, infiltration, accumulation of debris, or other defects.

END OF SECTION

# SECTION 01411 - TURBIDITY MONITORING

## PART 1 GENERAL

### 1.1 SCOPE

The work covered by this section consists of furnishing all labor, materials, and equipment, and performing all work required to obtain, analyze, and report the results of turbidity monitoring.

### 1.2 SUBMITTALS

Submit the following in accordance with the Section entitled "Submittal Procedures" in the General Conditions of the contract.

Calibration Standard

The Contractor shall furnish to the Owner a copy of the operating instructions and standards used in calibrating equipment used in collecting samples for turbidity.

Turbidity Monitoring

All required turbidity test reports shall be submitted (preferably by electronic mail) to the Owner, and the regulatory agencies as outlined in the permit conditions in the appendix of technical specifications.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.1 MONITORING REQUIREMENTS

#### 3.1.1 General

Inland water samples shall be obtained and analyzed for turbidity. Sampling shall be conducted in accordance with techniques described in the latest edition of "Standard Methods" published by the American Public Health Association (APHA), American Waterworks Association (AWWA), and Water Pollution Control Federation (WPCF), and other current techniques recognized by the scientific community and approved by the Jacksonville District, Corp of Engineers. Samples obtained for turbidity analysis shall be analyzed within 60 minutes of collection. Samples shall be taken with a sampler obtaining samples uncontaminated by water from any other depth.

##### 3.1.1.1 Turbidity Monitoring Equipment

Monitoring required for turbidity shall be measured in Nephelometric Turbidity Units (NTU) using a standard Nephelometer.

3.1.2 Dredging Location

Routine monitoring shall occur at the following locations and as specified in the permits.

3.1.2.1 Station Descriptions

a. Station 1 (Compliance Turbidity)

No more than 150 meters downcurrent of the dredge and in the direction of any visible plume.

b. Station 2 (Background Turbidity)

At least 150 meters upcurrent from the dredge and outside of any turbidity generated by the project.

3.1.2.2 Turbidity

Samples to be analyzed for turbidity shall be taken every four hours during construction hours and shall be collected from the surface and mid-depth at the following locations. Additional sampling shall be performed when the Owner determines that there may be non-compliance with water quality standards. The samples shall be analyzed on site within sixty minutes of collection.

a. Dredging Site Compliance at Station 1.

b. Dredging Site Background at Station 2.

3.2 TURBIDITY TESTS

3.2.1 Testing

The Contractor shall provide the owner with a certification, attesting to the accuracy of his testing equipment and procedure. The Contractor shall also provide the Owner with a duplicate of the standard used to calibrate his testing instrument as well as a complete set of operating instructions for the turbidity testing equipment. The Contractor and the Owner will use this standard throughout the project to maintain the calibration of the equipment. Whenever there is doubt as to the adequacy of the testing or validity of the results, the Owner may direct that additional tests be performed at no additional cost to the Owner.

3.2.2 Reporting

The monitoring data shall be recorded on forms that contain the pertinent information in the following paragraphs. Example forms are appended to the end of this Section. Other data shall be submitted in the form supplied by the laboratory chosen to do the analysis. All data shall be forwarded (preferably electronically) to the Owner, within 24 hours of collection. Reports shall be provided in a common format

such as Excel Spreadsheet (.xls) files, Word (.doc) files, Portable Document Format (.pdf), and Web Graphics (Joint Photographic Group or .jpg) files.

3.2.2.1 Report Contents

a. Permit application number.
b. Dates and times of sampling and analysis.
c. A statement describing the methods used in collection, handling, storage, and quality control methods used in the analysis of the samples.
d. A map indicating the sampling location and plume configuration, if any [(example map appended to the end of this Section)].
e. A map plotting the dredge location during each traverse through the borrow area. This map can be combined with the map indicating the sampling location.
f. A statement by the individual responsible for implementation of the sampling program concerning the authenticity, precision, limits of detection, and accuracy of the data.
g. Results of the analyses.
h. A description of any factors influencing the dredging or disposal operation or the sampling program. Reports shall be furnished daily even when no sampling is conducted. When sampling is not conducted, a brief statement shall be given in the report explaining the reason for not conducting the sampling, such as "dredge not working due to mechanical problems" or "no sampling taken due to high seas".

3.2.2.2 Monitoring Reports

Monitoring reports shall also include the following information for each day that samples are taken:

a. Time of day and date samples were taken.
b. Depth of water body.
c. Depth of sample.
d. Antecedent weather conditions.
e. Tidal stage and direction of flow.
f. Dredge location (station location and map).
g. Water sample location.
h. Wind direction and velocity.

3.2.2.3 Notification

If turbidity exceeds background levels by more than 29 NTU, the Contractor shall immediately notify the Owner, or on the morning of the following workday if it occurs after normal work hours. In addition, all dredging activity shall cease immediately and all measures to reduce turbidity shall be taken. Dredging shall not resume until corrective measures have been taken and turbidity has returned to acceptable levels as determined by proper testing described in subparagraph "Dredging Locations" above.

3.4 WORK DELAY

Delays in work due to the fault or negligence of the Contractor or the Contractor's failure to comply with this specification shall not be compensable. Any adjustments to the contract performance period or price that is

required because of compliance with this section shall be made in accordance with the provisions of the General Conditions.

3.5 SAMPLE - TURBIDITY MONITORING TEST REPORT

END OF SECTION

# SECTION 02491 - PIER TIMBERWORK

## PART 1 GENERAL

### 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

| | |
|---|---|
| AWPA C2 | (2000) Lumber, Timers, Bridge Ties and Mine Ties, Pressure Treatment |
| AWPA C18 | (1999) Material in marine Construction, Pressure Treatment |
| AWPA M4 | (2001) Care of Pressure - Treated Wood Products |
| AWPA M6 | (1996) Brands Used on Forest Products |

### 1.2 SUBMITTALS

The following shall be submitted in accordance with Section entitled “Submittal Procedures” in the General Conditions of the Contract.

Product Data

Structural Timber

Test Reports

Delivery Inspection List

Field inspect and submit a verification list of each treated timber member and each strapped bundle of treated lumber indicating the working and lettering of the quality control markings, the species and the condition of the wood. Do not incorporate materials damaged in transport from plant to site.

Timber Preservative Inspection

Submit the inspection report of an independent inspection agency, for approval by the Engineer that offered products complying with applicable AWPA Standards. Identify treatment on each piece by the quality mark of an agency accredited by the Board of Review of the American Lumber Standard Committee.

### 1.3 DELIVERY AND STORAGE

Open-stack timber and lumber material on skids at least 12 inches above ground, in a manner that will prevent warping and allow shedding of water. Close-stack treated timber and lumber material in a manner that will prevent long timbers or preframed material from sagging or becoming crooked. Keep ground under and within 5 feet of such piles free of weeds, rubbish, and combustible materials. Protect materials from

weather. Handle treated timber with ropes or chain slings without dropping, breaking outer fibers, bruising, or penetrating surface with tools. Do not use cant dogs, peaveys, hooks, or pike poles. Protect timber and hardware from damage.

## PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Lumber and Timbers (Solid Sawn)

a. Provide solid sawn lumber and timbers of stress-rated Southern Pine with the following stress ratings:

$F_b$ = 1,200 psi (Extreme Fiber Bending/Single Member);
(1,450 psi as indicated for observation platform)
$F_t$ = 500 psi (Tension Parallel to Grain)
$F_v$ = 90 psi (Horizontal Shear)
E = 1,500,000 (Modulus of Elasticity)
(Properties when moisture content exceeds 19 percent)

Materials shall be identified by the grade mark of a recognized association or independent inspection agency using the specific grading requirements of an association recognized as covering the species used. The association or independent inspection agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.

b. The following are the requirements for timber and lumber:

Joists: No. 2 Rough Sawn
Stringers: No. 1, S4S
Decking and Railing: No. 1, S4S
Cross Bracing: No. 2, Rough Sawn

2.1.2 Preservative Treatment

Fabricate lumber and timbers before preservative treatment. Each piece of treated lumber or timber shall be branded, by the producer, in accordance with AWPA M6. Treat wood to be used in contact with salt water or salt-water splash in accordance with AWPA C2 and AWPA C18 with Chromated Copper Arsenate (CCA), with the following retention:

| | |
|---|---|
| Joists: | 0.60 pcf |
| Stringers: | 0.60 pcf |
| Decking and Railing: | 0.40 pcf (see note below) |
| Cross Bracing | 0.60 pcf |

Note: Decking shall be treated with a preservative solution that contains a hydrocarbon wax/oil emulsion water repellent system stabilized with ethoxylated nonylphenol surfactants. The average particle size of the emulsion should range from 350-400 nm and the treated sapwood should contain a minimum 0.22 (pcf) water repellent solids. Decking/Railing may also be treated with ACQ in lieu of CCA.

## PART 3 EXECUTION

## 3.1 CONSTRUCTION

Cut, bevel, and face timbers prior to plant preservative treatment.

### 3.1.1 Framing

Cut and frame lumber and timber so that joints will fit over contact surface. Secure timbers and piles in alignment. Open joints are unacceptable. Shimming is not allowed. Bore holes for drift pins and dowels with a bit 1/16-inch less in diameter than the pin or dowel. Bore holes for truss rods or bolts with a bit 1/16-inch larger in diameter than rod or bolt. Bore holes for lag screws in two parts. Make lead hole for shank the same diameter as shank. Make lead hole for the threaded portion approximately two-thirds of the shank diameter. Bore holes in small timbers for boat or wire spikes with a bit of the same diameter or smallest dimension of the spike to prevent splitting. Counterbore for countersinking wherever smooth faces are indicated or specified.

## 3.2 FIELD TREATMENT

### 3.2.1 Timberwork

Field treat cuts, bevels, notches, refacing and abrasions made in the field in treated piles or timbers in accordance with AWPA M4. Trim cuts and abrasions before field treatment.

END OF SECTION

# SECTION 02492 - MARINE HARDWARE

## PART 1 GENERAL

### 1.1 RELATED DOCUMENTS

Drawings, Contract Documents and Division 1 Specification Sections, apply to this Section.

### 1.2 SUBMITTALS

Submit the following in accordance with the Section entitled "Submittal Procedures" in the General Conditions of the contract.

Factory Test Reports

Hardware Inspection

Submit the inspection report of an independent inspection agency, for approval by the Owner, which offered products complying with applicable ASTM Standards. Identify composition of each piece by the quality mark of an agency accredited by the Board of Review of the American Standard of Testing and Materials.

Field Test Reports

Delivery Inspection List

Field-inspect and submit a verification list of all hardware indicating the working and lettering of the quality control markings. Do not incorporate materials damaged in transport from plant to site.

Product Data

Screws
Bolts
Cleats and Hardware

### 1.3 DELIVERY AND STORAGE

Store all hardware in a covered environmentally controlled location on skids at least 12 inches above ground, in a manner that will prevent rusting or oxidation and allow shedding of water. Keep ground under and within 5 feet of chemicals, rubbish, and combustible materials. Protect materials from weather and damage.

## PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Hardware

Bolts with necessary nuts and washers, timber connectors, drift pins, dowels, nails, screws, spikes and other fastenings.

2.1.2 Bolts

Shall be stainless steel (316 alloy). Size(s) indicated on plans.

2.1.3 Marine Hardware

b. Cleats: Shall be Almag “S” or equivalent with stainless steel hardware.

PART 3 EXECUTION

3.1 Fastening

Vertical bolts shall have nuts on the lower end. Where bolts are used to fasten, timber to concrete, or timber to steel, bolt members together when they are installed and retighten immediately prior to final acceptance of contract. Provide bolts having sufficient additional threading to provide at least 3/8-inch per foot thickness of timber for future retightening.

END OF SECTION

# SUBSURFACE EXPLORATION REPORT
# AND ENGINEERING RECOMMENDATIONS
# SURFSIDE 96TH STREET PARK IMPROVEMENTS
# 9572 BAY DRIVE
# SURFSIDE, FL
# MAY 18, 2021
# FILE NO.: 21-2528


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May 18, 2021
File No.: 21-2528

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**SUBSURFACE EXPLORATION REPORT**
**SURFSIDE 96TH STREET PARK IMPROVEMENTS**
**9572 BAY DRIVE**
**SURFSIDE, FL**

## 1.0 Introduction

Ardaman & Associates, Inc. has completed the subsurface exploration and studies of the project site described in our proposal dated April 21, 2021. The work was requested by Ms. Kelly Hitzing and authorized by Mr. Barry Miller, both with Savino & Miller Design Studio. The purposes of performing this exploration were to evaluate the general subsurface conditions within the park property and provide recommendations for seawall improvements, foundation design, and site preparation. Our work included Standard Penetration Test (SPT) borings and visual engineering classification of the sampled soils. In addition, we have estimated the coefficient of design permeability of the soils. This report describes our explorations and tests, reports their findings, and summarizes our conclusions and recommendations.

The following sections of this report describe our explorations and explain our recommendations in greater detail. Our report has been prepared specifically for this project. It is intended for the exclusive use of Savino & Miller Design Studio, their representatives, and assigns. Our work has used methods and procedures consistent with local foundation engineering practices. No other warranty, expressed or implied, is made.

We do not guarantee project performance in any respect, only that our work meets normal standards of professional care.

## 2.0 Site Location and Description

The site for the proposed shoreline improvements is located at the Surfside 96 Street Park with property number 9575 Bay Drive, Surfside, FL (Section 35, Township 52S,

Range 42E). A site vicinity map provided by Google Earth Pro 2021 is presented in Figure 1.

## 3.0 Project Description

It is our understanding that the proposed construction will consist of seawall replacement, new structures, and drainage improvements.

## 4.0 Field Exploration

### 4.1 Soil Borings

To explore subsurface conditions at the site, four (4) Standard Penetration Test (SPT) borings were performed at the location shown on the Boring Location Plan in Figure 2. The SPT borings were completed to depths from 30 to 50 feet below grade. The work was performed in accordance with the procedures recommended in ASTM D-1586. A summary of these field procedures is included in the Appendix. The borings location was laid out at the approximate location shown in our boring location plan.

Our drillers examined the soil recovered from the SPT sampler and maintained a log for each boring. The soil samples were taken to our laboratory, where they were visually classified by our engineer. The soil classifications and other pertinent data obtained from our explorations are reported on the boring log included in the Appendix.

The soil samples recovered from our explorations will be kept in our laboratory for 30 days, then discarded unless you request otherwise. The groundwater level of the boring location was measured upon completion of drilling.

## 5.0 Subsurface Conditions

The boring logs in the Appendix present a detailed description of the soils encountered at the location at the depth explored. The soil stratification shown on the boring logs is based on the examination of recovered soil samples and interpretation of the driller's field log. It indicates only the approximate boundaries between soil types. The actual transitions between adjacent soil strata may be more gradual and indistinct.

The results of our test borings indicate the following general soil profile

| Depth Below Ground Surface (feet) | Description |
|---|---|
| 0 – 0.5 | Topsoil, silty organics |
| 0.5 – 3 | Fill, sand, loose |
| 3 – 23 | Sand, very loose |
| 23 – 38 | Limestone |
| 38 – 40 | Varies from sand, fine-grained, very loose to limestone, well cemented |
| 40 – 50 | Limestone, well cemented |

The above soil profile is outlined in general terms only. The exception to the above profile was found at boring B-2, where muck was found from 4 to 6 feet below grade. Please refer to the boring logs for soil profile details.

## 6.0 Groundwater Conditions

Our drillers observed groundwater in the boreholes at depths of about 3 feet below the ground surface, as noted on the boring logs. Fluctuations in the groundwater level on this site should be anticipated throughout the year due to a variety of factors, the most important of which is tidal fluctuations. Groundwater levels somewhat above the present levels should be expected after periods of heavy rains. We understand that water level conditions will be controlled by tidal cycles on the bay.

## 7.0 Exfiltration Tests

In order to estimate the hydraulic conductivity of the upper soils, four (4) locations were tested at three different elevations 5, 10, and 15 feet, for a total of twelve (12) constant head exfiltration tests. The test locations are shown in our Boring Location Plan in Figure 2. The tests were performed in accordance with methods described in the South Florida Water Management District (SFWMD) Permit Information Manual, Volume IV.

Descriptions of the soils observed in the exfiltration test boreholes and the test results are presented in the Appendix. In brief, the exfiltration tests yield a hydraulic conductivity of values of about $0.22 \times 10^{-4}$ cfs/ft$^2$-ft head to $5.97 \times 10^{-4}$ cfs/ft$^2$-ft head. Table 1 below summarizes the results of the exfiltration tests.

| Depth Tested (ft) | Exfiltration | Test Location | | | |
|---|---|---|---|---|---|
| | | B-1 ($k \times 10^{-4}$) | B-2 ($k \times 10^{-4}$) | B-3 ($k \times 10^{-4}$) | B-4 ($k \times 10^{-4}$) |
| 5 | Ex 1 | 0.22 | 0.47 | 0.33 | 0.443 |
| 10 | Ex 2 | 1.21 | 4.23 | 1.75 | 1.75 |
| 15 | Ex 3 | 5.55 | 4.11 | 3.85 | 5.97 |

*Table 1. Exfiltration Test Results*

## 8.0 Discussions and Recommendations

For the proposed seawall improvements, we have considered two options, either using a sheet pile wall or soldier piles with precast panels. Backfilling material for bulkhead structure should also follow the recommendations provided below.

### 8.1 Suitable Fill Material and Compaction of Fill Soils

All fill materials should be free of organic materials, such as roots and vegetation. We recommend using fill with less than 10 percent by dry weight of material passing the U.S. Standard No. 200 sieve size.

All structural fill should be placed in level lifts not to exceed 12 inches in un-compacted thickness. Each lift should be compacted to at least 95 percent of the modified Proctor (ASTM D-1557) maximum dry density value. The filling and compaction operations should continue in lifts until the desired elevation(s) is achieved. If hand-held compaction equipment is used, the lift thickness should be reduced to no more than 6 inches.

### 8.2 Reuse of Excavated Soils

The near-surface sand encountered on-site is appropriate for reuse as fill. However, all the fill material should be completely free of organic materials, such as roots and vegetation. If the upper limerock is to be reused, the contractor shall perform the excavation, making sure the fill material is free of organic materials.

### 8.3 Sheet Piles

Sheet pile installation may find hard driving within the limestone found at 23, 37, and 46 feet below grade. During the sheet pile installation, care should be exercised to avoid damaging any neighboring structures while the sheet pile driving operations are underway. Prior to starting the construction activities, a pre-construction survey of the adjacent structures should be performed. The existing conditions (i.e., cracks) of the

structures should be documented with photographs and video surveys (if deemed necessary). Construction activities should be ceased if deemed detrimental to adjacent structures.

## 8.4 Soil Engineering Properties for Bulkhead Design

Table 2 presents our recommended engineering properties for the soils found in our field exploration. Note that a cohesion value has been assigned to the limestone layers. These values are considered conservative based on numerous testing and physical evidence for this type of soil.

**Table 2**

| Fill or Soil type | Depth | Range SPT N Value | Average Moist Unit Weight (pcf) | Buoyant Soil Unit Weight (pcf) | Friction Angle | Cohesion (ksf) | 0.28 | Passive Pressure Coefficient | At Rest Pressure Coefficient | RQD |
|---|---|---|---|---|---|---|---|---|---|---|
| Sand, very loose | 0 to 23 | 0 – 13 | 115 | 64 | 30 | 0 | 0.28 | 3 | 0.53 | - |
| Silt/Silty organics, very soft | 4 to 6 | - | 0 | 30 | 18 | 0 | 0.5 | 2 | 0.69 | - |
| Limestone, cemented | 23 to 38 | 12 – 23 | 120 | 62 | 35 | 1000 | 0.25 | 4 | 0.41 | - |
| Limestone | 38 to 50 | 12 – 50 | 120 | 68 | 36 | 1000 | 0.27 | 3.69 | 0.43 | 20 |

Please notice that a conservative assumption regarding the friction angle between the retaining wall and the backfill material has been used to define the earth pressure coefficient. Factors of safety against sliding, overturning, and bearing capacity must be included in all earth pressure analyses. We recommend the following factors of safety:

1. Sliding 1.5
2. Overturning 2.0
3. Bearing Capacity 2.5

## 8.5 Auger Cast Concrete Piles

Soldier auger cast piles are recommended as an alternative for the seawall improvement using precast concrete panels. The soldier auger cast piles could be installed on the landside of the seawall. Pile installation should be performed following the pile installation recommendations provided in this report.

The following table presents our estimated allowable axial capacity for auger cast piles installed to the referenced depth below existing grade.

**TABLE 3**
**CAST-IN-PLACE CONCRETE PILES**
**Capacity in tons: Tension (T). Compression (C)**

| LENGTH (feet) | PILE DIAMETER (inches) | |
|---|---|---|
| | 14 | 16 |
| 30 | 12 (T) 35 (C) | 20 (T) 41 (C) |

The recommendations presented in Table 3 are based on the analysis performed using the estimated properties of the different layers. The pile length has been calculated from the existing grade at the boring location. The capacities presented in Table 3 were limited to a 30-foot-long pile to provide a solution not requiring a load test.

### 8.6 Auger Pile Installation Recommendations

Auger cast piles should be installed at designated locations in accordance with the following installation recommendations. The recommended procedures should be covered in the project specifications and completed prior to the construction of the pile caps.

1. The drilling tools should consist of a continuous flight, hollow-stem auger mounted on rigid leads, suspended from a crane boom. Fixed leads are recommended to aid in maintaining the auger at the desired inclination. Sufficient auger length should be provided to allow drilling of each pile to a depth of 10 feet below the design pile bottom elevation if needed.

2. The drilling and grouting of each pile should be performed as a continuous operation. The auger flights should be advanced at a steady rate, without stalling. Moreover, the power source should have sufficient rotary capacity to minimize the volume of soil brought to the surface by the augers, as they are advanced to the design depth. This is necessary to minimize the consequent stress relief, which occurs when the augers withdraw excess soil from the sides of the augered hole and may result in the reduction of side friction capacity of the pile. We recommend that the volume of soil brought to the surface during the advancement of the auger be limited to no more than 1.80 cubic feet per foot length of the pile.

3. The piles are to be advanced to the design depth. Following completion of the advancement of the augers to the design pile depth, the auger stem should be lifted to a distance of 2 feet, the auger bottom cap should be dislodged, and grout should be introduced through the augers into the bottom of the hole to fill the two-foot thick void. The auger stem should then be re-lowered to the bottom of the hole. Grout should then be pumped through the auger stem at a rate sufficient to maintain a head of at least 7 feet above the tip of the auger. During grouting operations, the auger should be continuously withdrawn and slowly rotated to expel the soils on the flights. Sufficient grout should be made continuously available to enable the grouting of each pile to be performed continuously from bottom to top.

4. The volume of grout introduced into each pile hole should exceed the theoretical volume of the excavated hole by at least 20 percent.

5. Piles should not be installed within a distance of six pile diameters of any pile constructed within the previous 24 hours. If the concrete level in any completed pile drops, the pile should be rejected and replaced. If there is difficulty in placing the reinforcement steel in any pile, the pile should be re-drilled. All reinforcement steel should be fitted with spacers to allow easier installation into the auger-hole piles and ensure its centering.

6. Following completion of the grouting of the piles, steel reinforcement may be installed, and the top of the pile prepared to receive the pile cap. The grout should then be allowed to cure, as necessary, prior to preparing the soil to receive the pile cap.

7. Following the required grouting curing period, continuous pile cap trenches should be excavated to cap line and bottom grade. Subgrade soils should be compacted with suitable mechanical equipment to produce a firm bearing surface. Forms and steel reinforcement may then be erected, and the pile cap concrete may be cast and allowed to cure.

8. After steps 1 through 7 are completed, fill necessary to raise the grade to finished floor subgrade, or any interim working grade, should then be placed in 6-inch layers and compacted to a minimum of 95 percent of the Modified Proctor maximum dry density of the compacted material. All fill material should consist of clean granular soils free of organics and other deleterious materials, with not more than eight percent by dry weight passing the U.S. No. 200 sieve and no particle larger than 3 inches in diameter.

## 8.7 Driven Piles

Driven Precast Concrete Piles may be used to support the lateral and compression load for the proposed new wall. In order to install the driven piles, pre-drilling may be needed.

### 8.7.1 Precast Concrete Piles

Estimated precast concrete pile allowable capacities are presented below.

**TABLE 4**
**DRIVEN PRECAST CONCRETE PILES**
**Capacity in tons: Tension (T), Compression (C)**

| LENGTH* (feet) | PILE DIMENSION (inch) |
|---|---|
| | 14 x 14 |
| 25 | 6 (T) 25 (C) |

*Length of the pile from existing grade at the time of our exploration.

Please note that the compression capacity of the piles takes into account the surface frictional resistance and tip bearing. On the other hand, the tension capacity of the piles is based solely upon the surface frictional resistance. We recommend a pile length of 25 feet to ensure proper embedment to support lateral loads. A cantilever larger than 6 feet will require a deeper pile to support the recommended lateral capacity discussed below.

Pile length longer than our recommended length may be necessary to achieve our estimated capacity. This is due to the fact that soils encountered at boring locations may differ from the soils at pile locations. We recommend that several test piles be driven before establishing the pile length. Please notice that the analyses were performed for single piles. Results are included in the Appendix.

### 8.7.2 Lateral Load Analysis

We have completed an engineering analysis to determine the lateral pile capacity for the 14-inch precast concrete pile installed to 35 feet below existing grade. The upper six feet of the pile were considered in cantilever to complete the analysis.

The study was performed using the L-Pile computer program. The input data was developed from the information contained in this report and from engineering judgment. Horizontal loads in the range of 0 to 10 kips were applied to a head of the pile at grade

beam level. Allowable lateral load may be defined by the structural engineer based on the allowable displacement at the top of the pile. Results of the analysis for the allowable lateral load of 4 kips are attached to this report.

Please, note that lateral pile displacement and allowable capacity depend on not only the soil conditions but also the combination of axial and lateral forces considered, as well as on the reinforcement assigned to the pile. In this case, we have considered in the analysis 10 kips of axial compression load.

## 9.0 Quality Assurance

We recommend establishing a comprehensive quality assurance program to verify that all site preparation and foundation and pavement construction are conducted in accordance with the appropriate plans and specifications. Materials testing and inspection services should be provided by Ardaman & Associates.

In-situ density tests should be conducted during backfilling activities and below all footings and floor slabs to verify that the required densities have been achieved. In-situ density values should be compared to laboratory Proctor moisture-density results for each of the different natural and fill soils encountered.

## 10.0 Closure

The analysis and recommendations submitted herein are based upon the data obtained from the soil borings presented in the Appendix and the assumed loading conditions. This report does not reflect any variations which may occur adjacent to or between the borings. The nature and extent of the variations between the borings may not become evident until during construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations presented in this report after performing on-site observations during the construction period and noting the characteristics of the variations

We are pleased to be of assistance to you in this phase of your project. When we may be of further service to you or should you have any questions, please contact us.

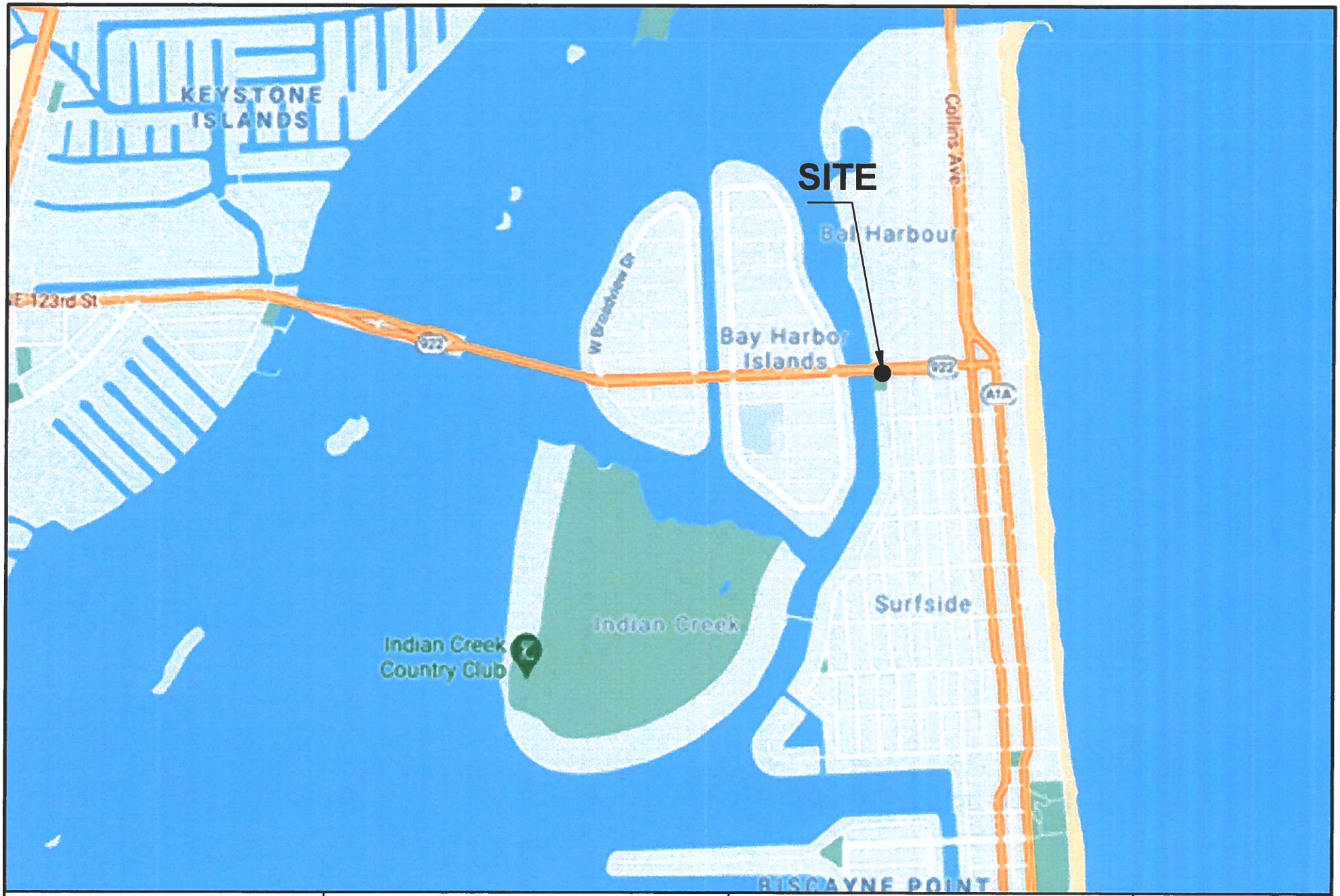
Very truly yours,
**ARDAMAN & ASSOCIATES, INC.**
**FL Certificate No. 0005950**

Gabriela Gonzalez
Staff Engineer

Evelio Horta Jr., M.S.C.E, P.E
Project Engineer
FL Reg. No. 82209

Evelio Horta, Ph.D., P.E., G.E.
Principal Engineer
FL Reg. No. 46625

# SITE PLAN
# AND
# BORING LOGS




| | | | |
|---|---|---|---|
| Ardaman & Associates, Inc.<br>Geotechnical, Environmental and Materials Consultants | SUBSURFACE EXPLORATION<br>96 STREET PARK IMPROVEMENTS<br>9572 BAY DRIVE<br>SURFSIDE, FLORIDA | SITE LOCATION PLAN<br><br>Figure No. 1 | File No.: 21-2528<br>Prepared By: EHJr<br>Date: 5/19/21 |


| | | | |
|---|---|---|---|
| Ardaman & Associates, Inc.<br>Geotechnical, Environmental and<br>Materials Consultants | SUBSURFACE EXPLORATION<br>96 STREET PARK IMPROVEMENTS<br>9572 BAY DRIVE<br>SURFSIDE, FLORIDA | BORING<br>LOCATION PLAN<br><br>Figure No. 2 | File No.: 21-2528<br>Prepared By: EHJr<br>Date: 05/19/21 |

# APPENDIX

## STANDARD PENETRATION TEST BORING LOGS

Our borings describe subsurface conditions only at the locations drilled and at the time drilled. They provide no information about subsurface conditions below the bottom of the boreholes. At locations not explored, surface conditions that differ from those observed in the borings may exist and should be anticipated.

The information reported on our boring logs is based on our drillers' logs and on visual examination in our laboratory of disturbed soil samples recovered from the borings. The distinction shown on the logs between soil types is approximate only. The actual transition from one soil to another may be gradual and indistinct.

The groundwater depth shown on our boring logs is the water level the driller observed in the borehole when it was drilled. These water levels may have been influenced by the drilling procedures, especially in borings made by rotary drilling with bentonitic drilling mud. An accurate determination of groundwater level required long-term observation of suitable monitoring wells. Fluctuations in groundwater levels throughout the year should be anticipated.

The absence of a groundwater level on certain logs indicates that no groundwater data is available. It does not mean that no groundwater will be encountered at the boring location.

# STANDARD PENETRATION TEST BORINGS

The Standard Penetration Test is a widely accepted method of testing foundation soils in place. The N-Value obtained from the test has been correlated empirically with various soil properties. These empirical correlations allow satisfactory estimates to be made of how the soil is likely to behave when subjected to foundation loads. Tests are usually performed in the boreholes at intervals of five feet. In addition, our Firm performs tests continuously in the interval directly below the expected foundation bearing grade where the soils will be most highly stressed.

Boreholes where Standard Penetration Tests will be performed are drilled with a truck-mounted CME 45A drill rig. The boreholes are advanced by rotary drilling with a winged bit that makes a hole about three inches in diameter. A bentonitic drilling mud is recirculated in order to remove the cuttings and support the walls of the borehole. The drag bit is specially modified to direct the mud upward and reduced disturbance of the soil ahead of the bit.

Occasionally, running or squeezing ground is encountered that cannot be stabilized by the drilling mud alone. In addition, drilling mud may be lost into the soil or rock strata that are unusually pervious. In such cases, flush-coupled steel casing with an outside diameter of about 3.5 inches is driven as a liner for the borehole.

After the borehole has been advanced to the depth where a Standard Penetration Test will be performed, the soil sampler used to run the test is attached to the end of the drill rods and lowered to the bottom of the borehole. The testing procedure used conforms closely to the methods recommended in ASTM D-1586. The sampler used has a split-barrel 24 inches long and an outside diameter of 2.0 inches. It is driven into the ground below the bottom of the borehole using a hammer that weighs 140 pounds and falls 30 inches. The driller records the number of hammer blows need to advance the sampler the second and third six-inch increments constitutes the test result; that is, the N-Value at the depth. The test is completed after the sampler has been driven not more than 24 inches or when refusal is encountered, whichever occurs first. Refusal occurs when 50 hammer blows advance the sampler six inches or less. After the test is completed, the sampler is removed from the borehole and opened.

The driller examined and classified the soil recovered by the sampler. He places representative soil specimens from each test in closed glass jars and takes them to our laboratory. In the laboratory, additional evaluations and tests are performed, if needed. The driller's classifications may be adjusted, if necessary, to conform more closely to the United Soil Classification systems, ASTM D-2487. Jar samples are retrained in our laboratory for sixty days, then discarded unless our clients request otherwise.

After completion of a test boring, the water level in the borehole is recorded.

# STANDARD PENETRATION TEST BORING LOG

## BORING 1

PROJECT: Surfside 96 Street Park
9572 Bay Drive, Surfside, FL

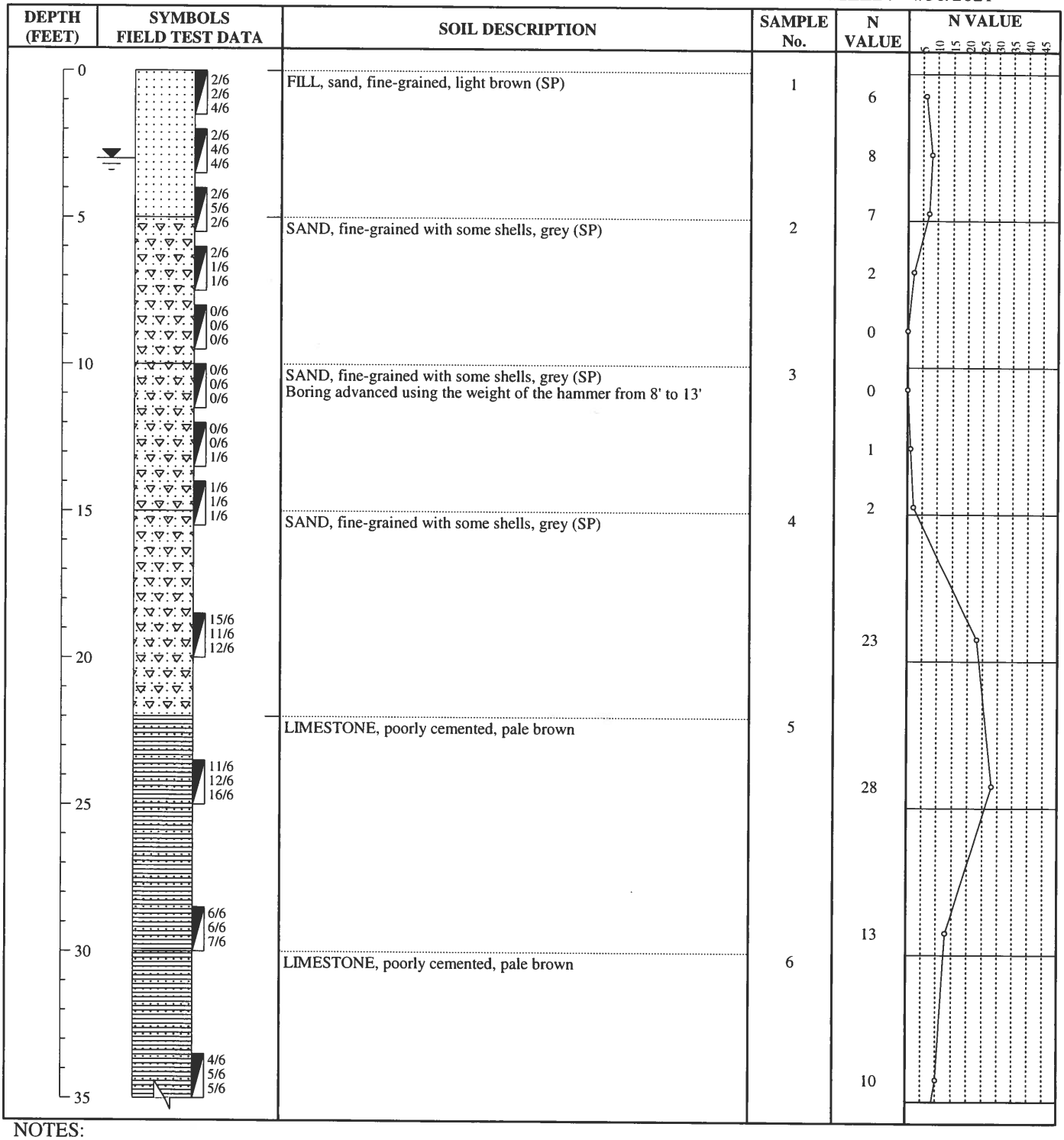
FILE No.: 21-2528

BORING LOCATION: See Plan

DRILL CREW: EG/FCH

WATER OBSERVED AT DEPTH 3'

DATE DRILLED: 4/30/2021




NOTES:

**FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN"** **140-LB HAMMER, 30-INCH FALL.** **(ASTM D-1586)**

# STANDARD PENETRATION TEST BORING LOG

## BORING 1

PROJECT: Surfside 96 Street Park
9572 Bay Drive, Surfside, FL

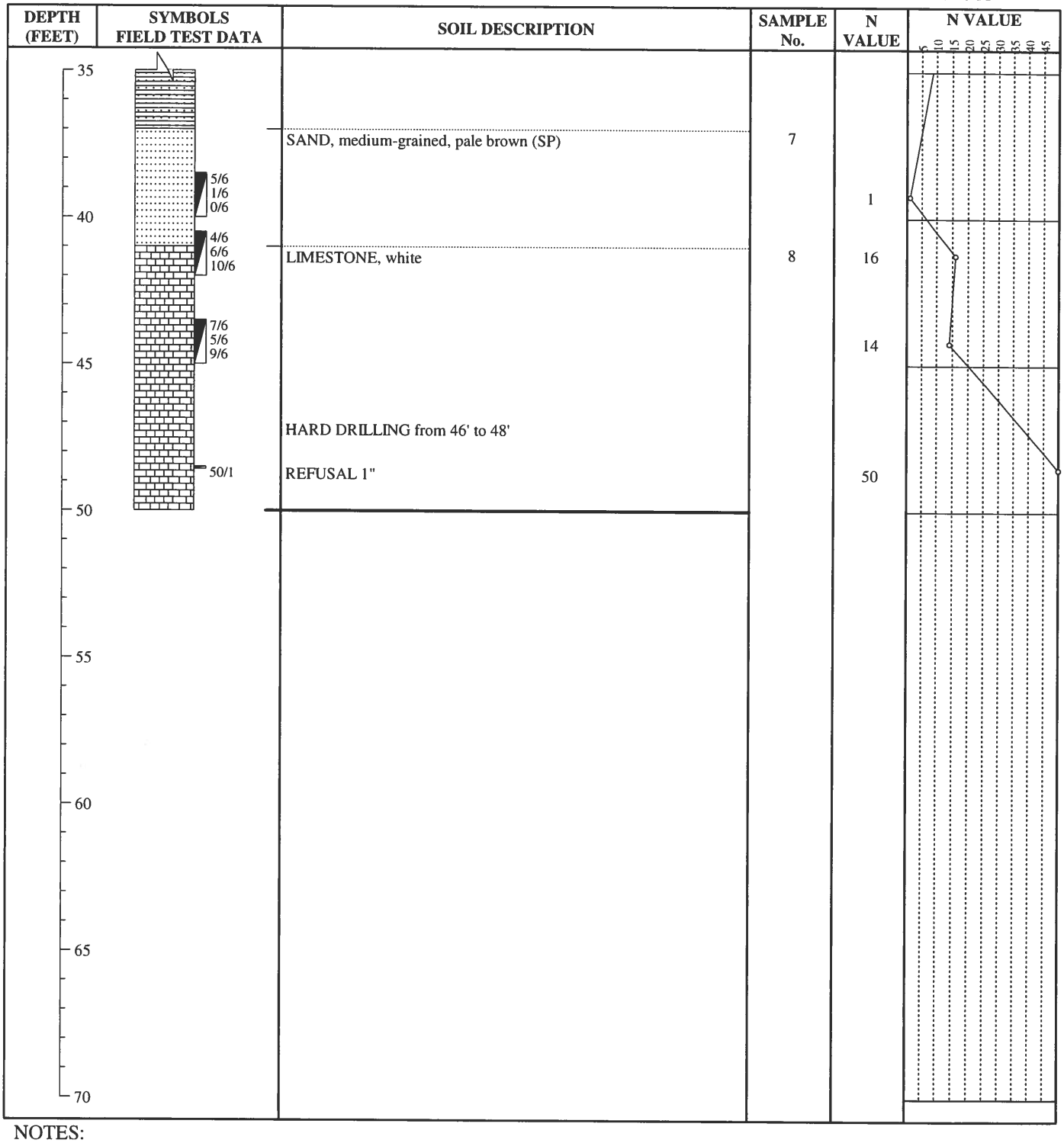
FILE No.: 21-2528

BORING LOCATION: See Plan

DRILL CREW: EG/FCH

WATER OBSERVED AT DEPTH 3'

DATE DRILLED: 4/30/2021




NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN". 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

# STANDARD PENETRATION TEST BORING LOG

## BORING 2

PROJECT: Surfside 96 Street Park
9572 Bay Drive, Surfside, FL

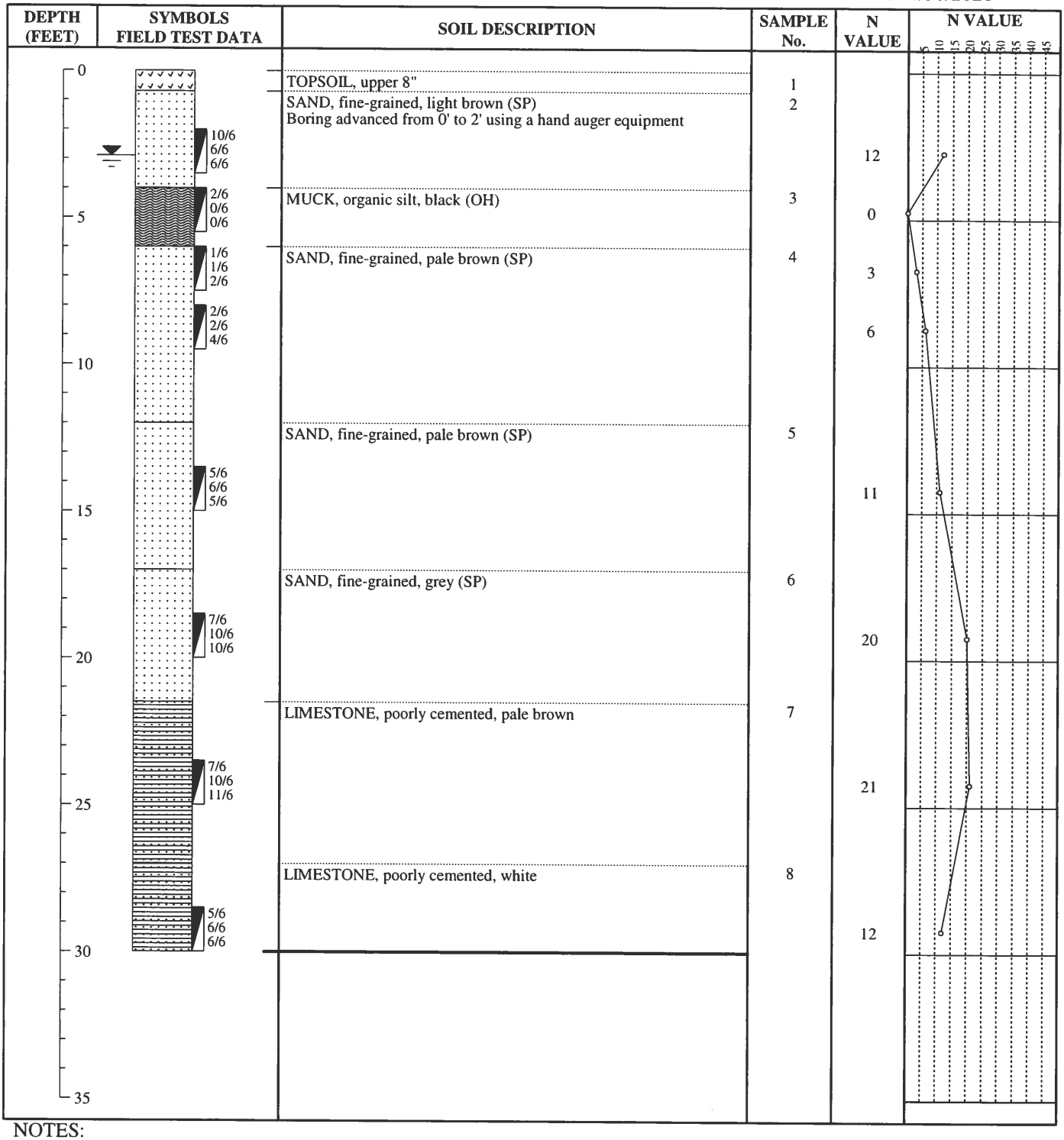
FILE No.: 21-2528

BORING LOCATION: See Plan

DRILL CREW: EG/FCH

WATER OBSERVED AT DEPTH 2.9'

DATE DRILLED: 4/30/2021




NOTES:

**FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN"** **140-LB HAMMER, 30-INCH FALL.** **(ASTM D-1586)**

# STANDARD PENETRATION TEST BORING LOG

## BORING 3

PROJECT: Surfside 96 Street Park
9572 Bay Drive, Surfside, FL

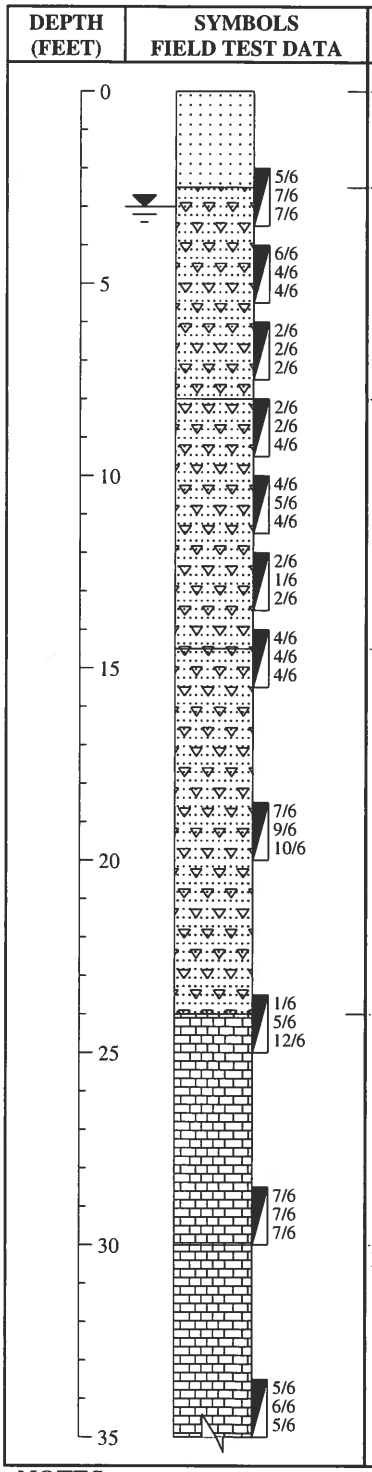
FILE No.: 21-2528

BORING LOCATION: See Plan

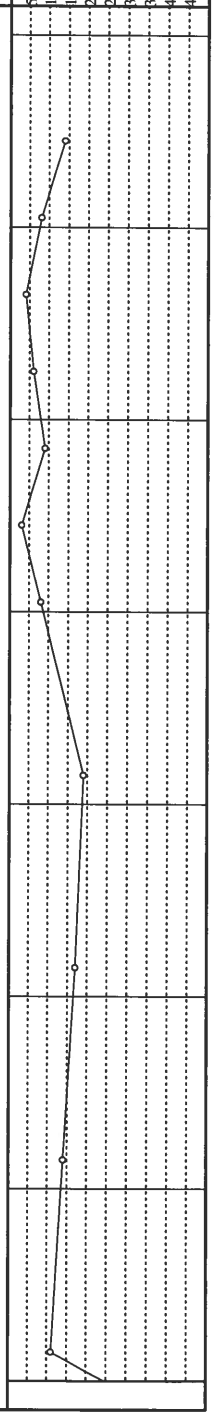
DRILL CREW: EG/FCH

WATER OBSERVED AT DEPTH 3'

DATE DRILLED: 5/3/2021




| DEPTH (FEET) | SYMBOLS FIELD TEST DATA | SOIL DESCRIPTION | SAMPLE No. | N VALUE |
|---|---|---|---|---|
| | | FILL, sand, fine grained, brown (SP)<br>Boring advanced from 0' to 2' | 1 | |
| | | SAND, medium to fine-grained with some shell, grey (SP) | 2 | 14 |
| | | | | 8 |
| | | | | 4 |
| | | SAND, medium to fine-grained with some shell, grey (SP) | 3 | 6 |
| | | | | 9 |
| | | | | 3 |
| | | SAND, medium-grained with some shell, light brown (SP) | 4 | 8 |
| | | | | 19 |
| | | LIMESTONE, white | 5 | 17 |
| | | | | 14 |
| | | LIMESTONE, white | 6 | |
| | | | | 11 |




NOTES:

**FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN"** **140-LB HAMMER, 30-INCH FALL.** **(ASTM D-1586)**

# STANDARD PENETRATION TEST BORING LOG

## BORING 3

PROJECT: Surfside 96 Street Park
9572 Bay Drive, Surfside, FL

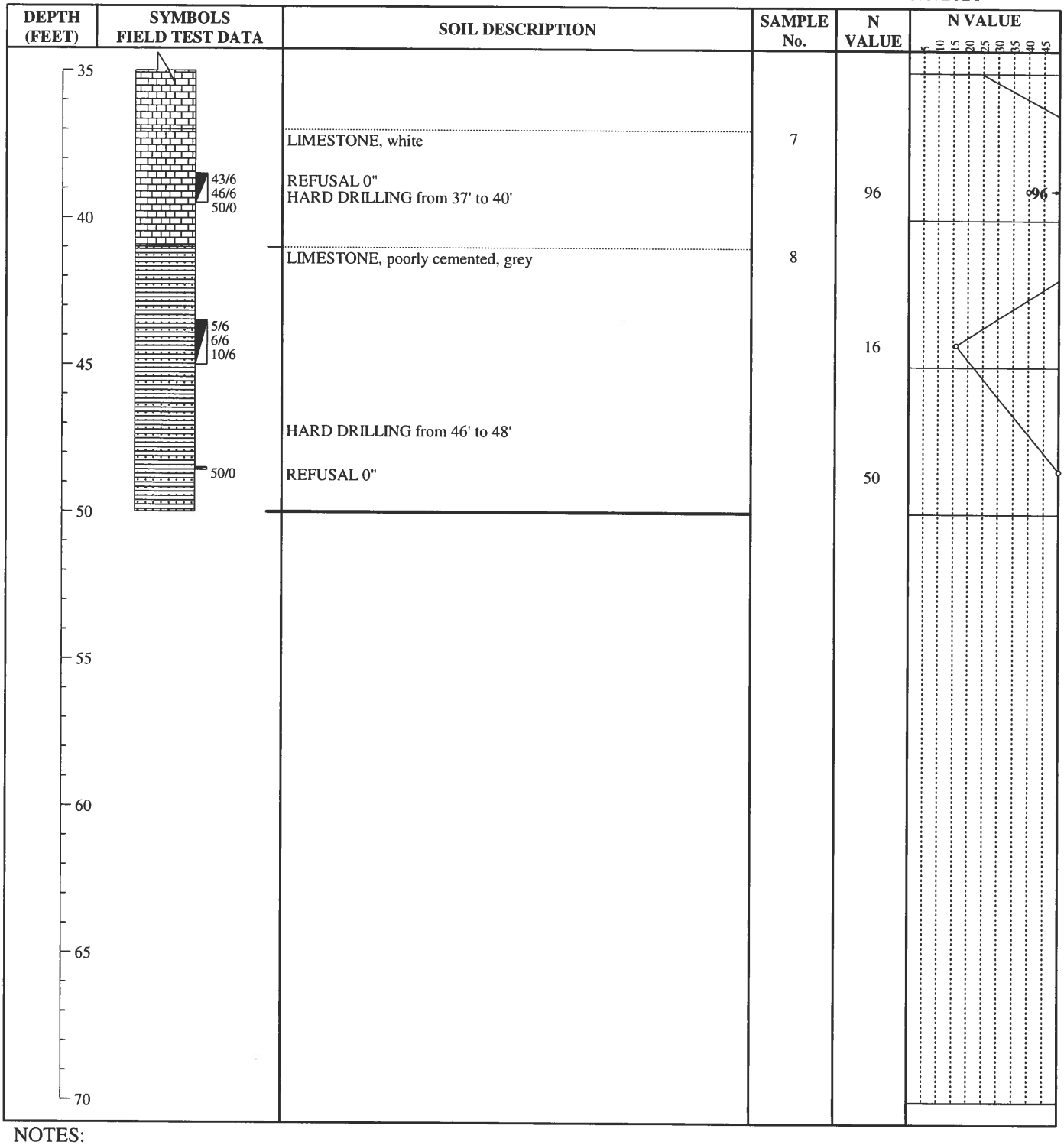
FILE No.: 21-2528

BORING LOCATION: See Plan

DRILL CREW: EG/FCH

WATER OBSERVED AT DEPTH 3'

DATE DRILLED: 5/3/2021




NOTES:

FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN". 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)

# STANDARD PENETRATION TEST BORING LOG

## BORING 4

PROJECT: Surfside 96 Street Park
9572 Bay Drive, Surfside, FL

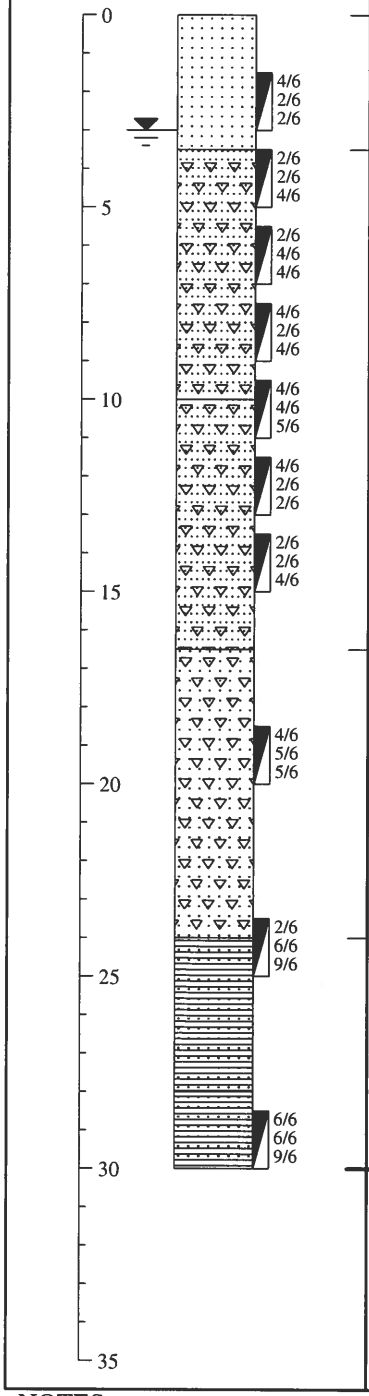
FILE No.: 21-2528

BORING LOCATION: See Plan

DRILL CREW: EG/FCH

WATER OBSERVED AT DEPTH 3'

DATE DRILLED: 5/3/2021




| DEPTH (FEET) | SOIL DESCRIPTION | SAMPLE No. | N VALUE |
|---|---|---|---|
| 0 | FILL, sand, fine-grained, light brown (SP) | 1 | |
| | Boring advanced from 0' to 1.5' using a hand auger equipment | | 4 |
| 5 | SAND, medium-grained with some shells, grey (SP) | 2 | 6 |
| | | | 8 |
| | | | 6 |
| 10 | SAND, medium-grained with some shells, grey (SP) | 3 | 9 |
| | | | 4 |
| | | | 6 |
| 15 | SAND, fine-grained with some shells, grey (SP) | 4 | |
| | | | 10 |
| 20 | | | |
| 25 | LIMESTONE, poorly cemented | 5 | 15 |
| | LIMESTONE, poorly cemented | 6 | |
| 30 | | | 15 |
| 35 | | | |

N VALUE: 5 10 15 20 25 30 35 40 45

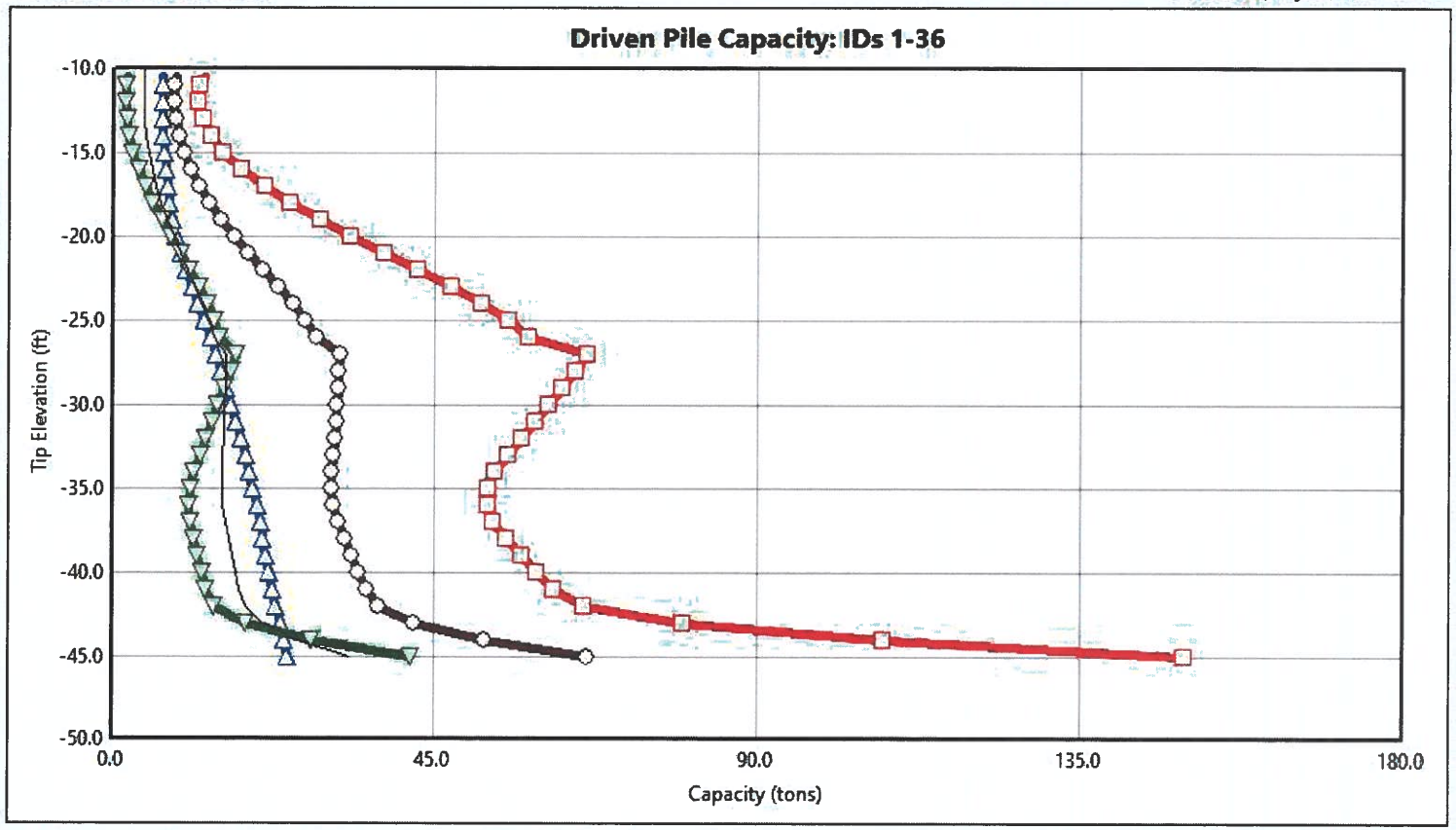
NOTES:

**FIELD TEST DATA ARE "BLOWS"/"INCHES DRIVEN" 140-LB HAMMER, 30-INCH FALL. (ASTM D-1586)**

# DRIVEN PILE CAPACITIES

Job Name: Surfside 96 Park

State Job (Project) #: 21-2528




Curves

- ☑ Ultimate Side Friction
- ☑ Mobilized End Bearing
- ☑ Ultimate Pile Capacity
- ☑ Estimated Davisson Capacity
- ☑ Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

| | | |
|---|---|---|
| Boring Number: | B4 | |
| Ground Surface Elevation | 0.00 | (ft) |
| Section: | Square | |
| Width | 14.00 | (in) |

Project Data

| | |
|---|---|
| File: | 21-2528 Surfside park |
| Date: | May 17, 2021 |
| Engineer: | AAI |

Analysis Data

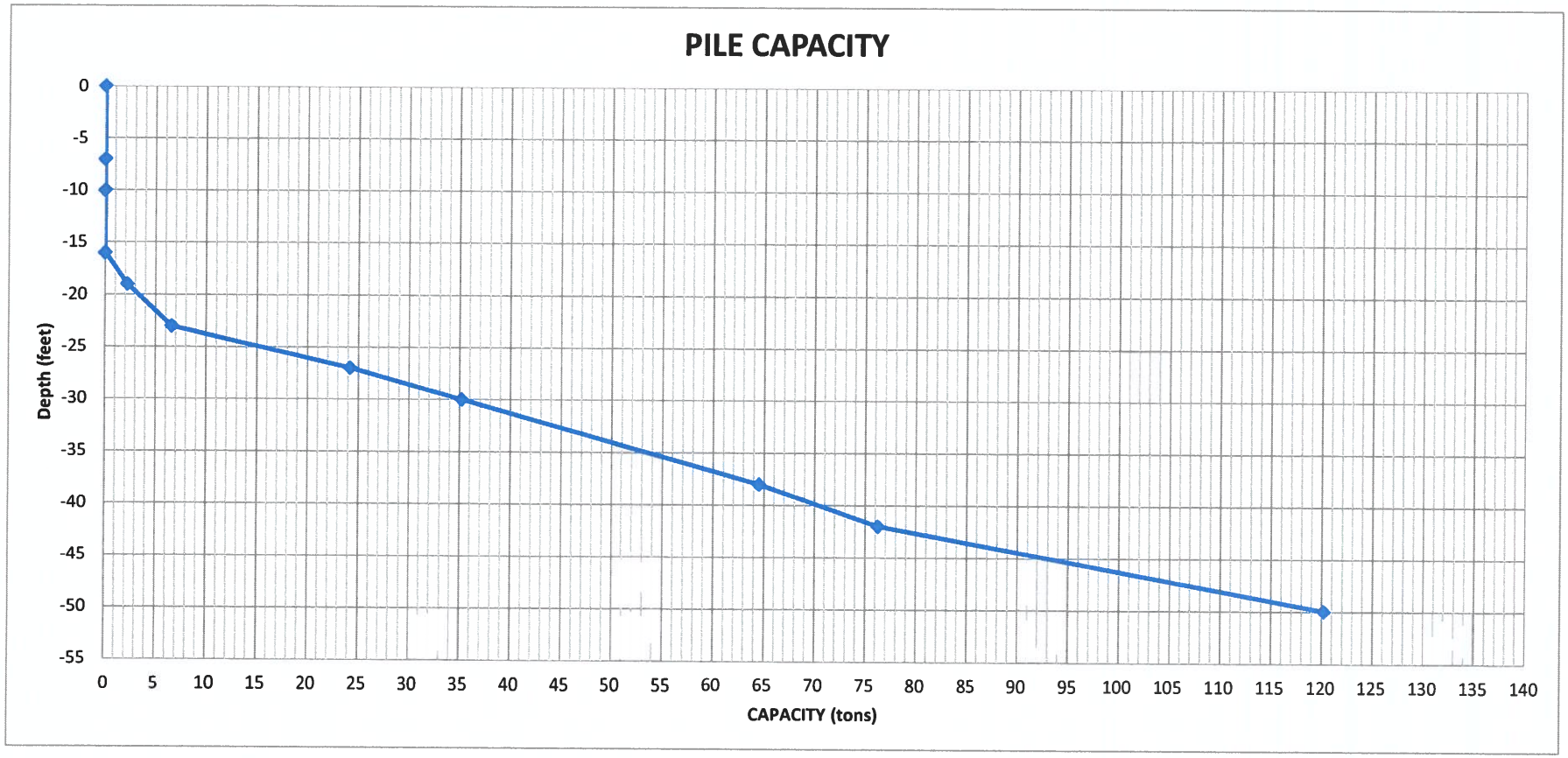
| | |
|---|---|
| Analysis Type: | SPT |

# PILE ALLOWABLE CAPACITY

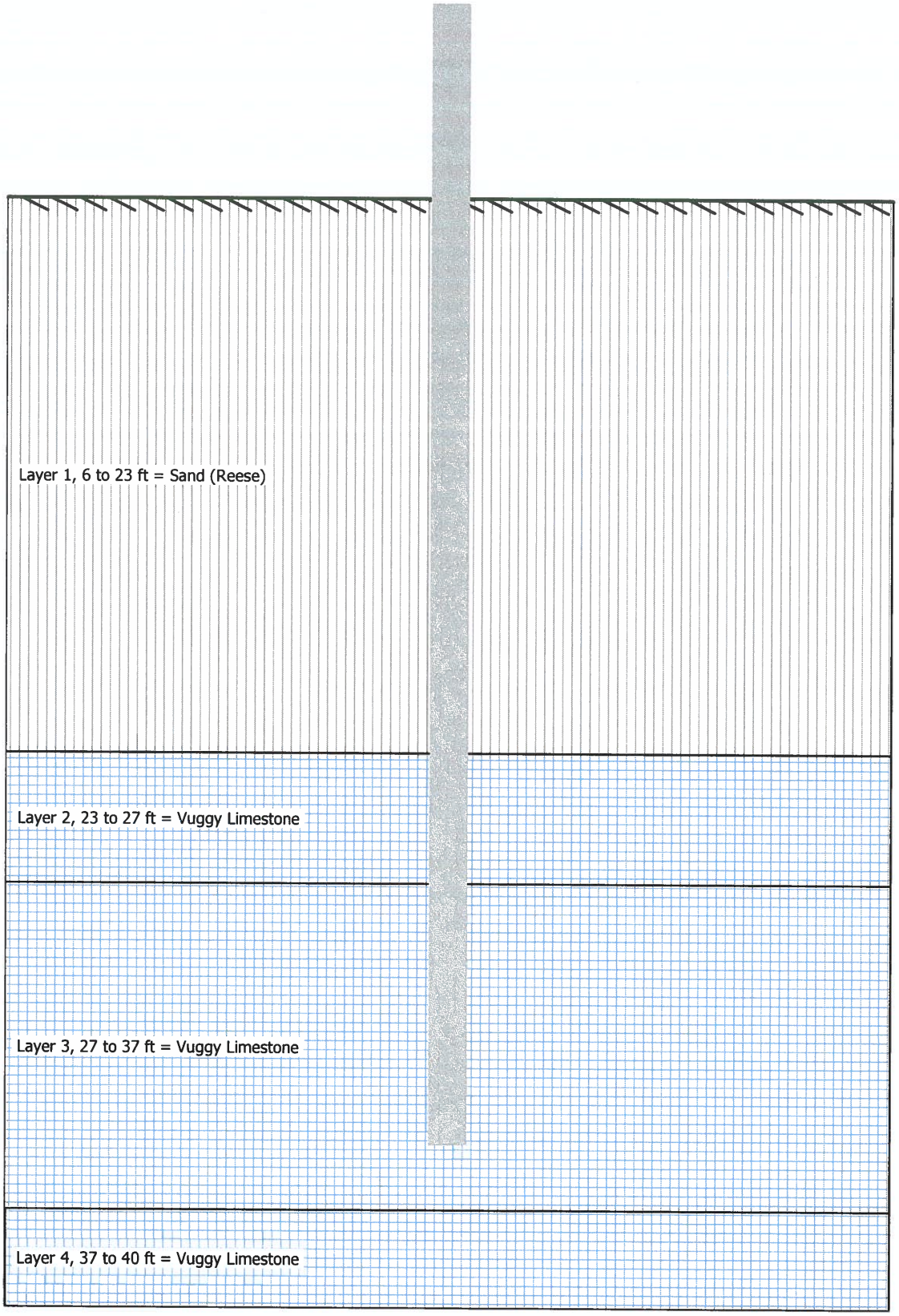
Seawall and buildings
9572 Bay Drive

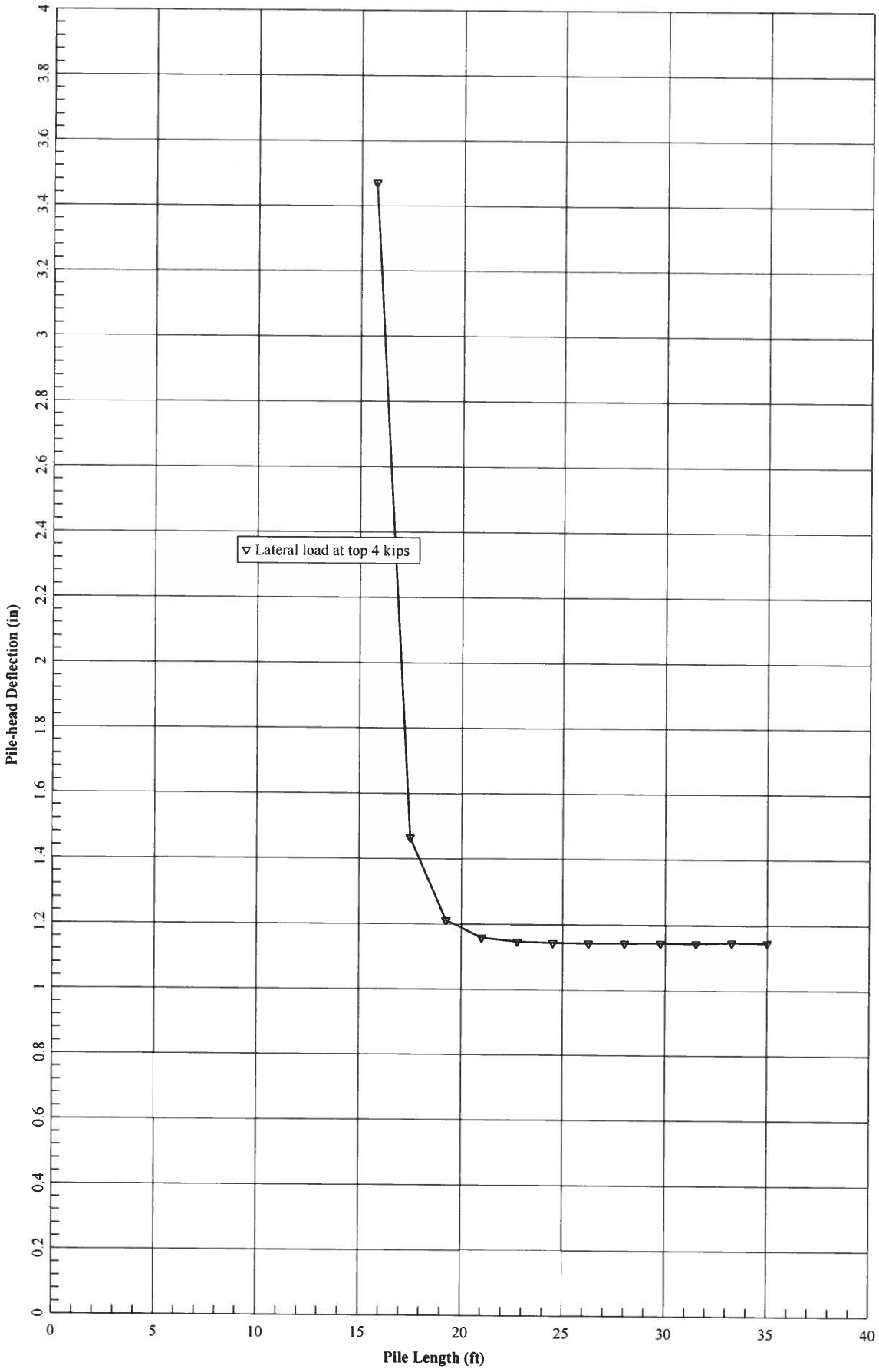
Engineer: A&A
File No: 21-2528

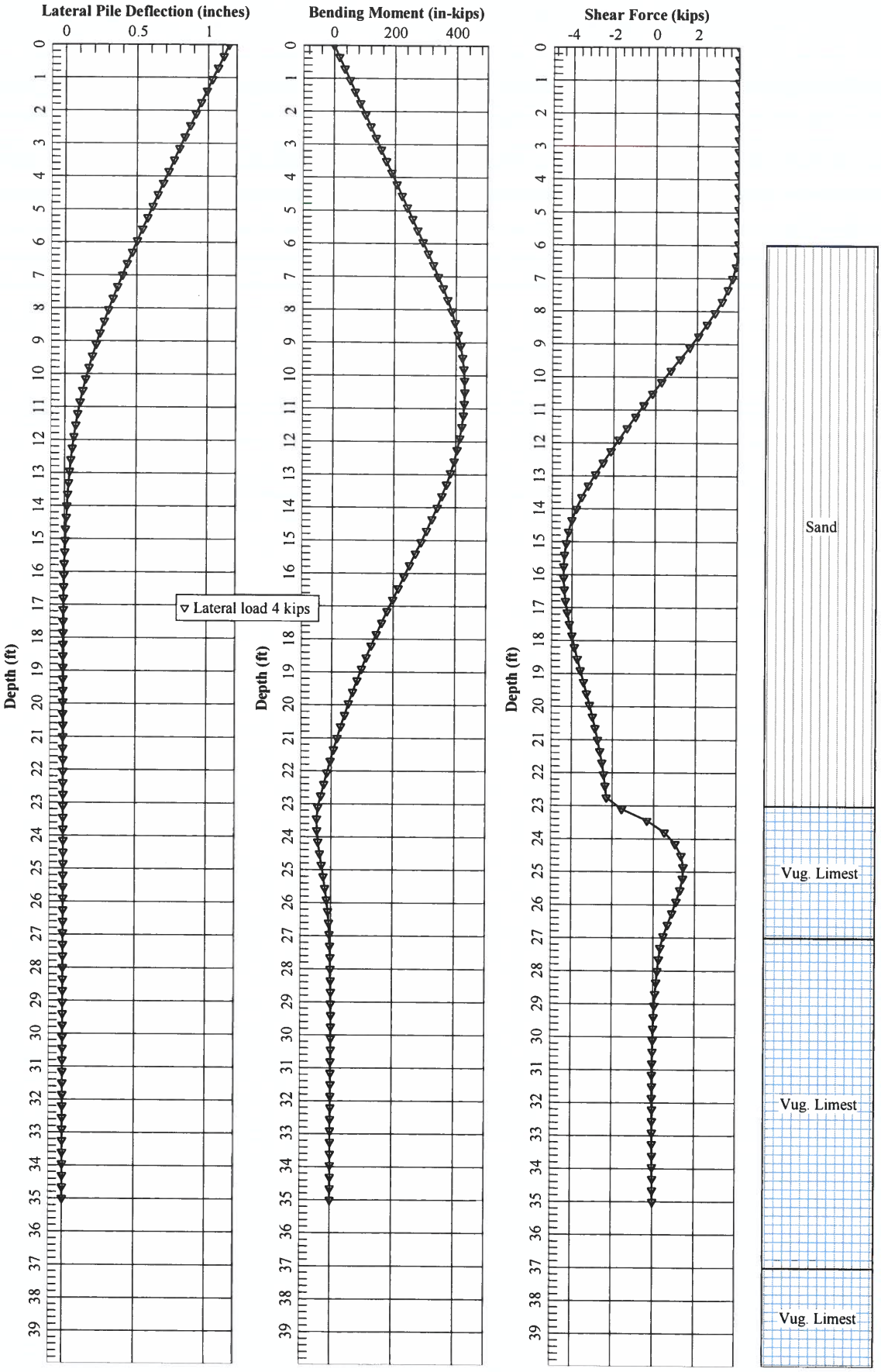
Boring No: B-1
Auger Size: 14



# LATERAL LOAD ANALYSIS




Lateral load at top 4 kips
Pile-head Deflection (in)
Pile Length (ft)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
2.2
2.4
2.6
2.8
3
3.2
3.4
3.6
3.8
4
0
5
10
15
20
25
30
35
40


Lateral Pile Deflection (inches)
0
0.5
1
Depth (ft)
Lateral load 4 kips
Bending Moment (in-kips)
0
200
400
Depth (ft)
Shear Force (kips)
-4
-2
0
2
Depth (ft)
Sand
Vug. Limest
Vug. Limest
Vug. Limest

# SFWMD CONSTANT HEAD

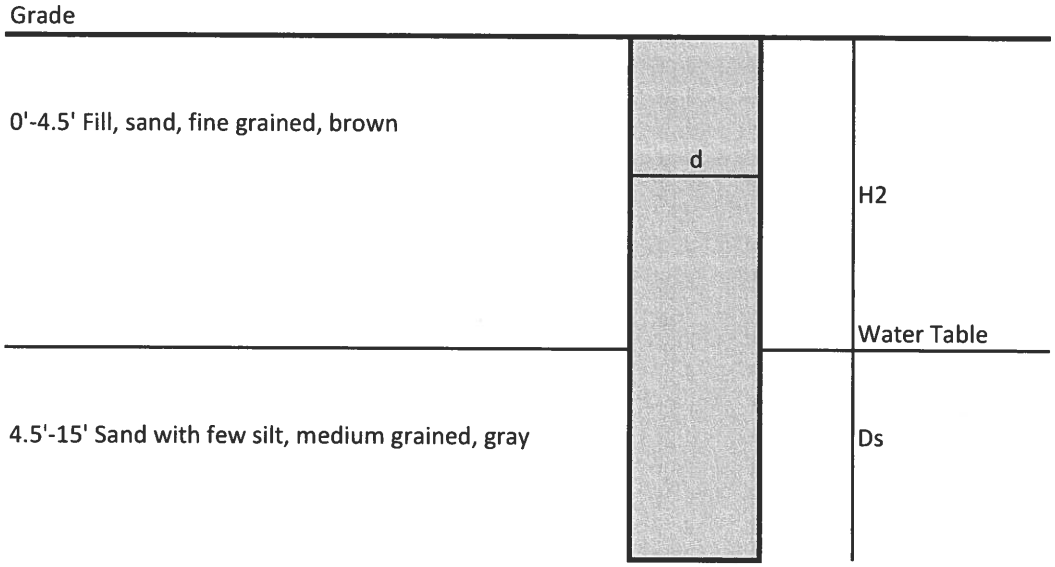
# EXFILTRATION TEST

**Surfside Park**

12-May-21
File No. 21-2528

9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B1 Exf 1

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 2.19E-05 |
| Q= Stabilized Flow Rate (cfs) | 3.74E-04 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 2 |
| H= Test Hole Depth (ft) | 5 |

Evelio Horta 5/18/21

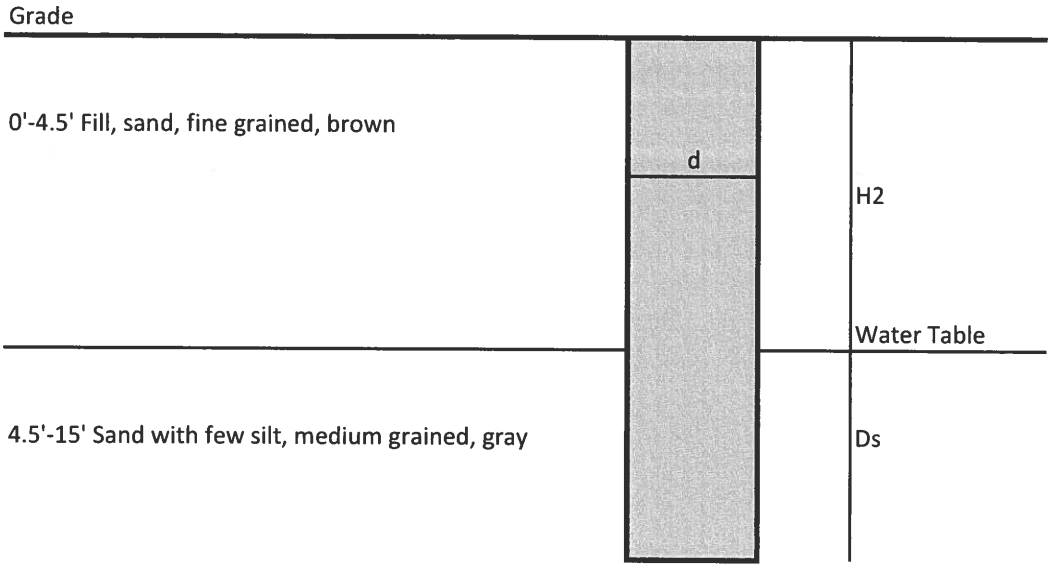
Evelio Horta,PhD.,PE.,GE.
Principal Engineer
FL Reg. No. 46625

**Surfside Park**

12-May-21
File No. 21-2528

9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B1 Exf 2

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 1.21E-04 |
| Q= Stabilized Flow Rate (cfs) | 4.90E-03 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 7 |
| H= Test Hole Depth (ft) | 10 |

5/18/21

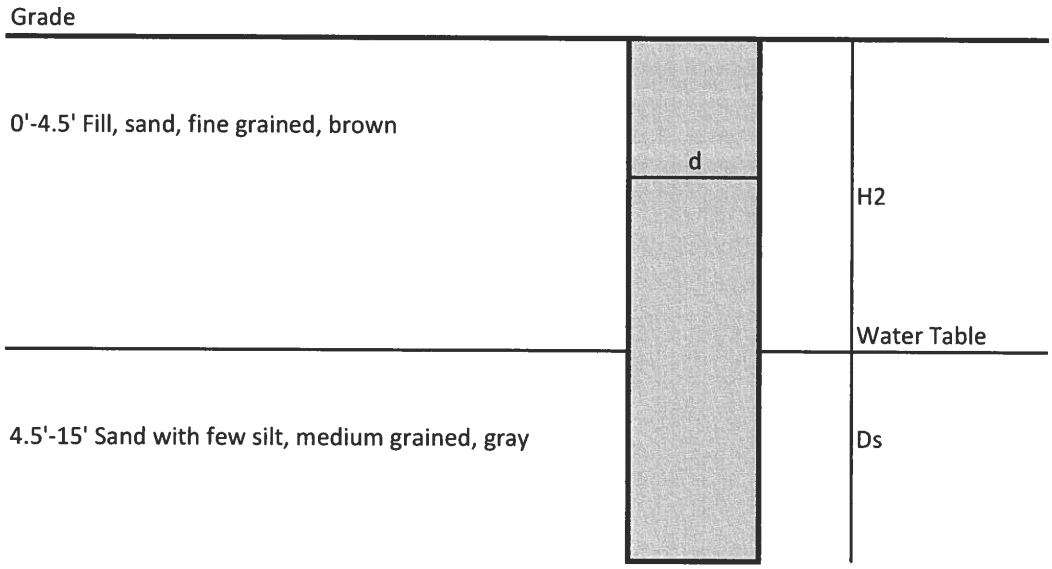
Evelio Horta,PhD.,PE.,GE.
Principal Engineer
FL Reg. No. 46625

**Surfside Park**

12-May-21
File No. 21-2528

9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B1 Exf 3

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 5.55E-04 |
| Q= Stabilized Flow Rate (cfs) | 3.56E-02 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 12 |
| H= Test Hole Depth (ft) | 15 |

Evelio Horta 5/18/21

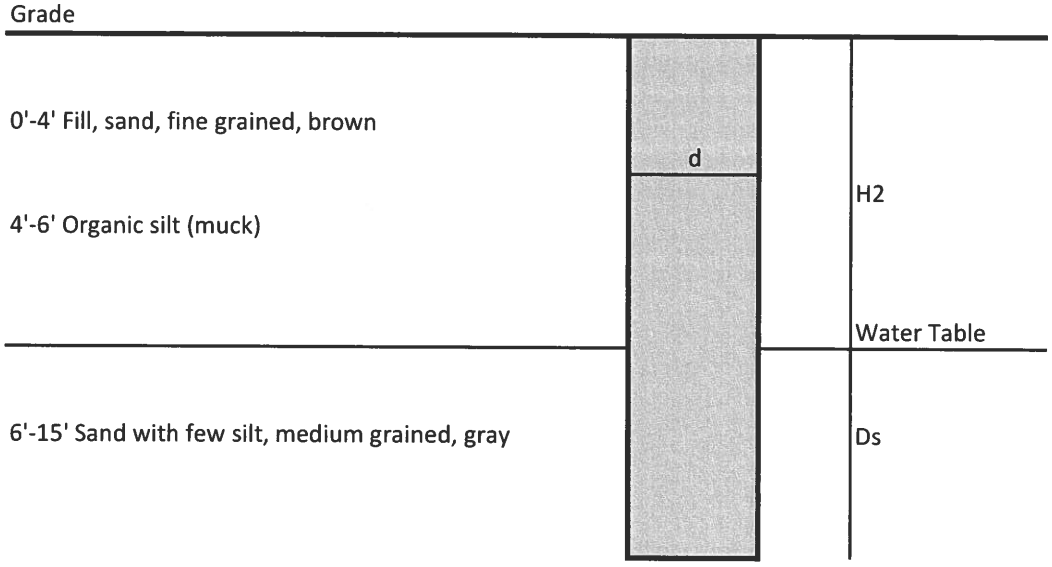
Evelio Horta,PhD.,PE.,GE.
Principal Engineer
FL Reg. No. 46625

**Surfside Park**

12-May-21
File No. 21-2528

9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B2 Exf 1

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 4.66E-05 |
| Q= Stabilized Flow Rate (cfs) | 7.80E-04 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 2.90 |
| Ds= Saturated Hole Depth (ft) | 2.1 |
| H= Test Hole Depth (ft) | 5 |

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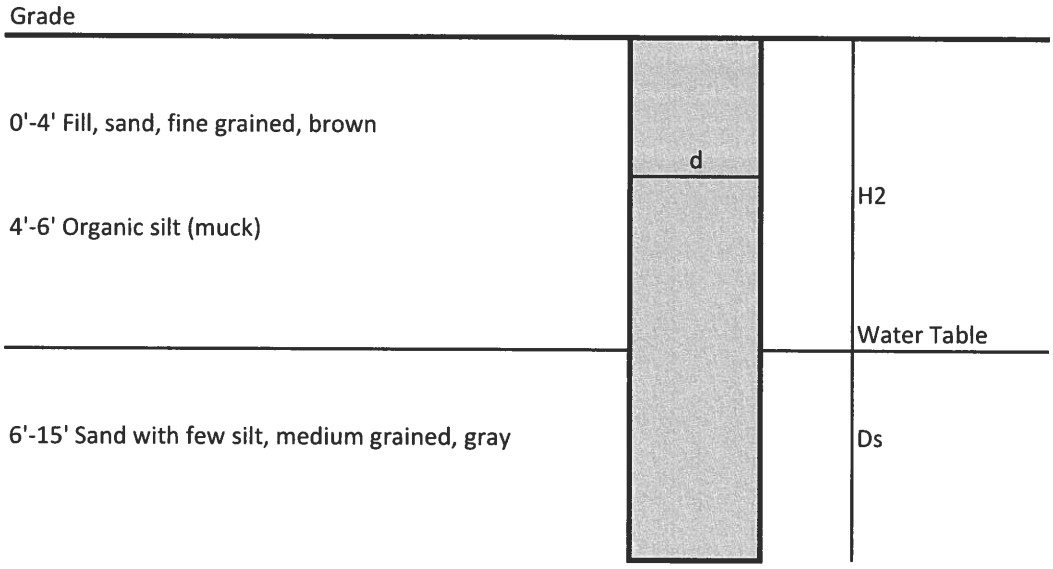
**Surfside Park**

12-May-21
File No. 21-2528

9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B2 Exf 2

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 4.23E-04 |
| Q= Stabilized Flow Rate (cfs) | 1.67E-02 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 2.90 |
| Ds= Saturated Hole Depth (ft) | 7.1 |
| H= Test Hole Depth (ft) | 10 |

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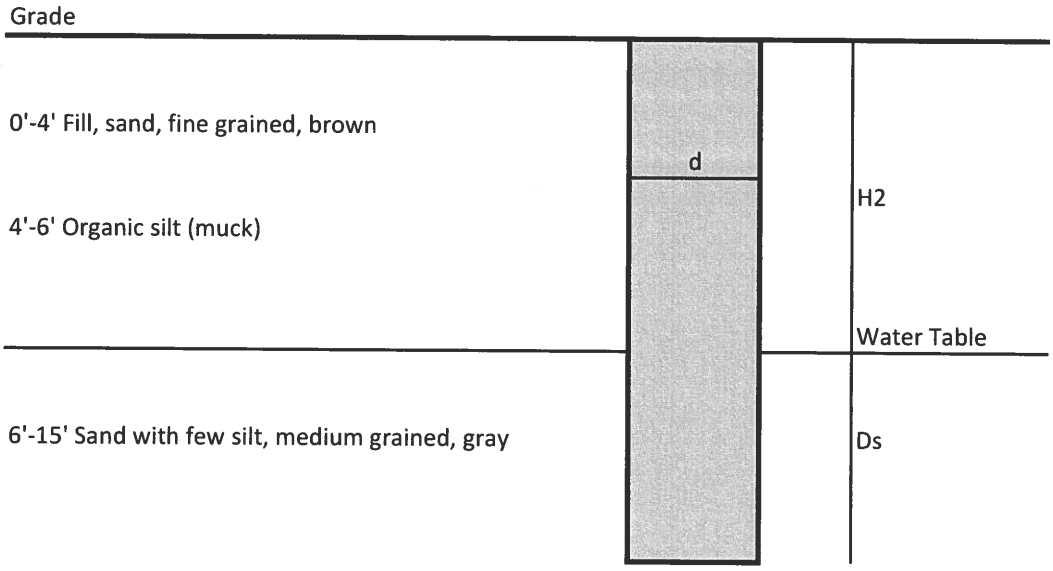
9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B2 Exf 3

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 4.11E-04 |
| Q= Stabilized Flow Rate (cfs) | 7.09E-02 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 12.10 |
| Ds= Saturated Hole Depth (ft) | 2.9 |
| H= Test Hole Depth (ft) | 15 |

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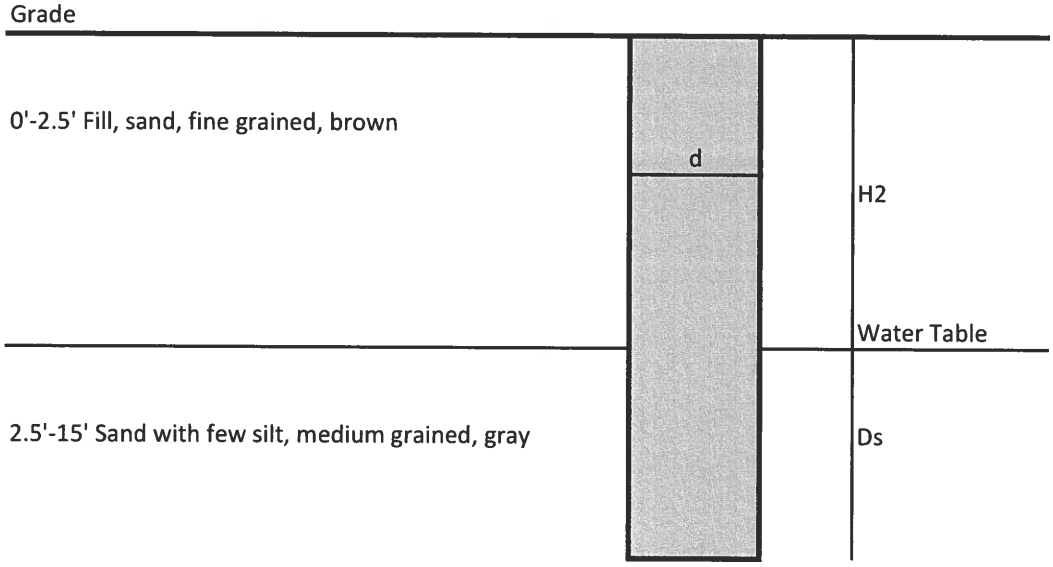
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B3 Exf 1

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 3.26E-05 |
| Q= Stabilized Flow Rate (cfs) | 5.57E-04 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 2 |
| H= Test Hole Depth (ft) | 5 |

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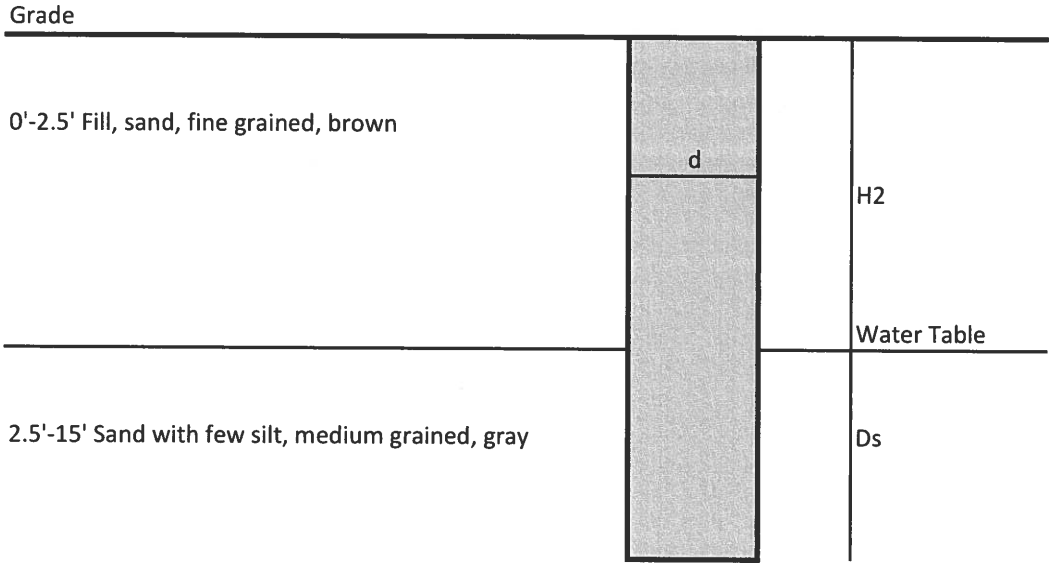
9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B3 Exf 2

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 1.75E-04 |
| Q= Stabilized Flow Rate (cfs) | 7.13E-03 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 7 |
| H= Test Hole Depth (ft) | 10 |

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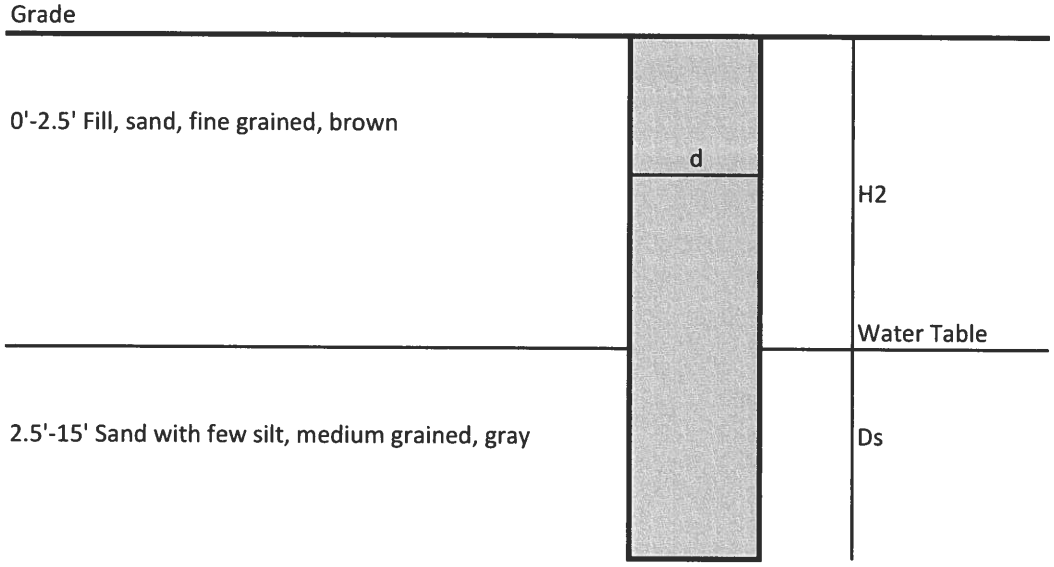
9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B3 Exf 3

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 3.85E-04 |
| Q= Stabilized Flow Rate (cfs) | 2.47E-02 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 12 |
| H= Test Hole Depth (ft) | 15 |

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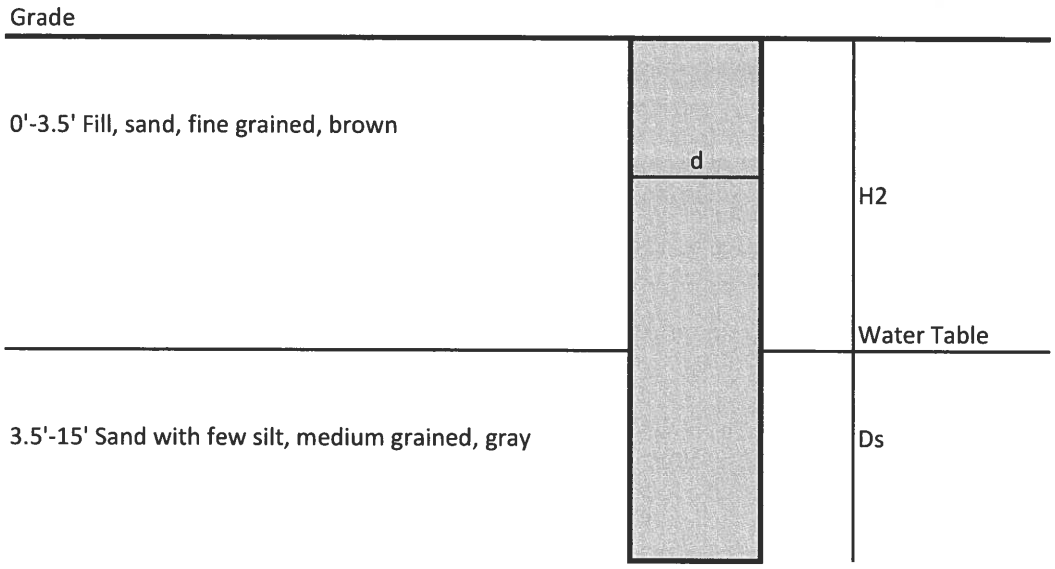
9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B4 Exf 1

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 4.43E-05 |
| Q= Stabilized Flow Rate (cfs) | 7.58E-04 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 2 |
| H= Test Hole Depth (ft) | 5 |

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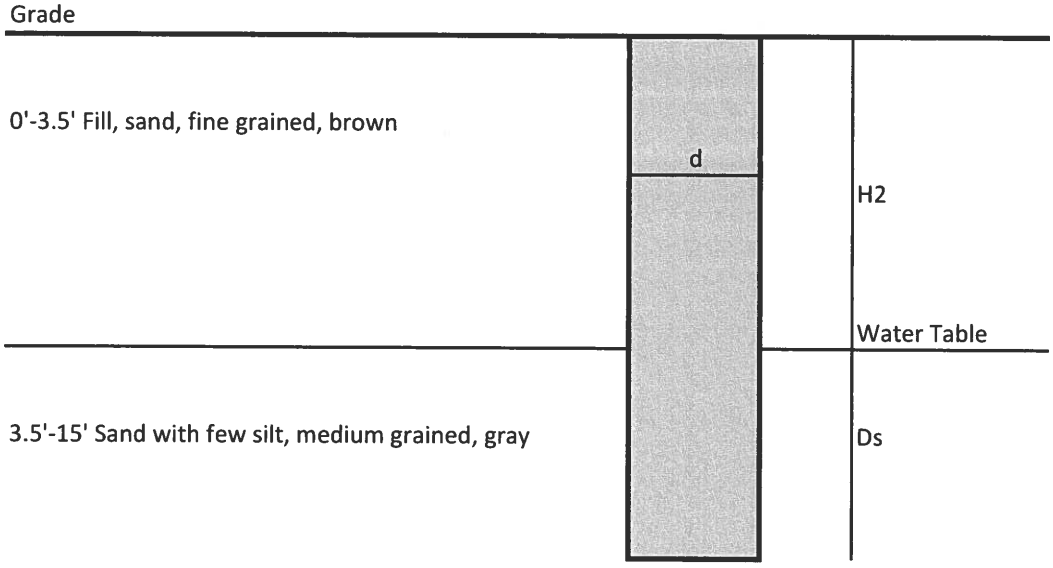
9572 Day Drive
CONSTANT HEAD PERCOLATION TEST
SFWMD Usual Open Hole Test
B4 Exf 2

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 1.75E-04 |
| Q= Stabilized Flow Rate (cfs) | 7.13E-03 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 7 |
| H= Test Hole Depth (ft) | 10 |

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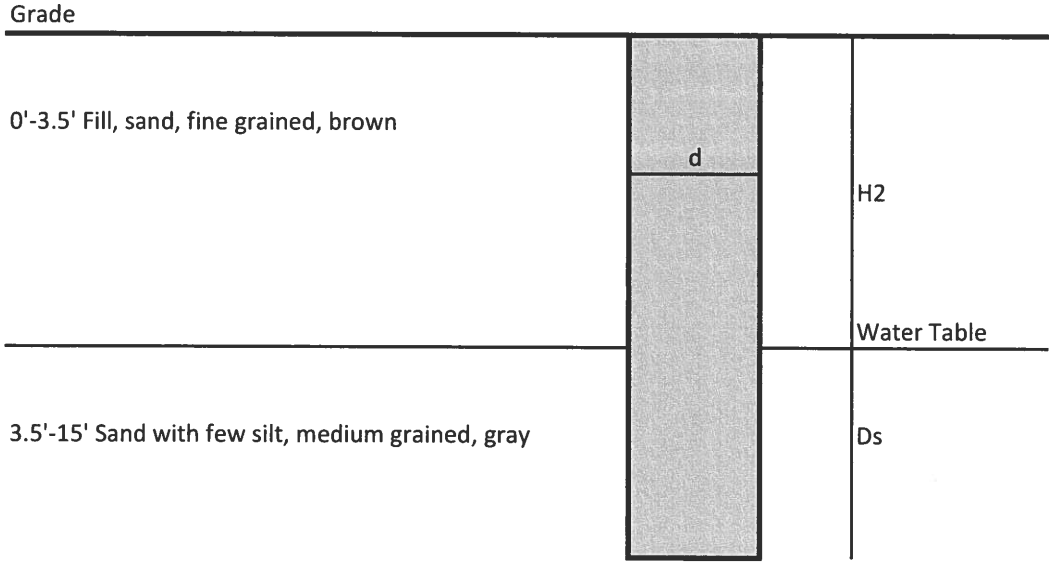
SFWMD Usual Open Hole Test
B4 Exf 3

Location:see plan




| | |
|---|---|
| K= Hydraulic Conductivity (cfs/ft$^2$-ft head) | 5.97E-04 |
| Q= Stabilized Flow Rate (cfs) | 3.83E-02 |
| d= Diameter of Test Hole (ft) | 0.5 |
| H2= Depth of Water Table (ft) | 3.00 |
| Ds= Saturated Hole Depth (ft) | 12 |
| H= Test Hole Depth (ft) | 15 |

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