

**LUMBERTON REGIONAL AIRPORT (LBT)  
T-HANGAR AND 2-UNIT BOX HANGAR  
163 AIRPORT BOULEVARD  
LUMBERTON, NC 28358**

**PROJECT MANUAL – VOLUME B-1  
JANUARY 17, 2025**

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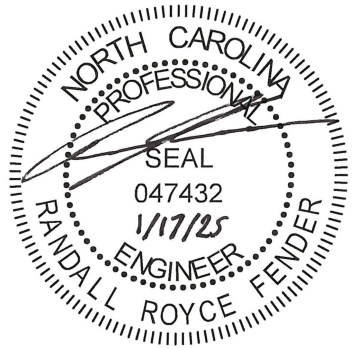
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1.1 DESIGN PROFESSIONALS OF RECORD


A. Architect

ARCHITECT'S CORPORATION	<p><b>The Wilson Group Architects</b> #51140</p> <p>For Specifications Sections accompanied by “The Wilson Group” in the header area of the document and not otherwise prepared by other design professionals of record.</p>	
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B. Civil Engineer

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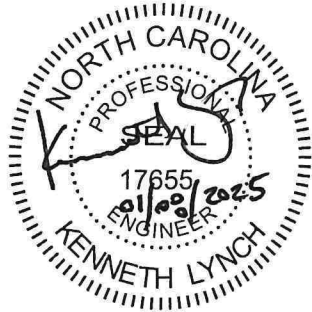
C. Structural Engineer

ENGINEER'S CORPORATION	<b>Stewart</b> NC Firm No. : F-1536  For Specifications Sections accompanied by "Stewart" in the header area of the document and not otherwise prepared by other design professionals of record.	
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D. Plumbing Engineer

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E. Mechanical Engineer

ENGINEER'S CORPORATION	<b>Cheatham &amp; Associates, P.A.</b> NC Firm No. : C-1073  For Specifications Sections accompanied by "Cheatham & Associates, P.A." in the header area of the document and not otherwise prepared by other design professionals of record.	
ENGINEER	<b>Kenneth Lynch, PE, LEED AP</b> NC No. 17655  For Specifications Sections accompanied by "Cheatham & Associates, P.A." in the header area of the document and not otherwise prepared by other design professionals of record.	

F. Electrical Engineer

ENGINEER'S CORPORATION	<b>Cheatham &amp; Associates, P.A.</b> NC Firm No. : C-1073  For Specifications Sections accompanied by "Cheatham & Associates, P.A." in the header area of the document and not oth- erwise prepared by other design profes- sionals of record.	
ENGINEER	<b>Mark A. Ciarrocca, PE</b> NC No. 17593  For Specifications Sections accompanied by "Cheatham & Associates, P.A." in the header area of the document and not oth- erwise prepared by other design profes- sionals of record.	

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## 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. Form liners.
  - 3. 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. Exposed surface form-facing material.
  - 2. Concealed surface form-facing material.

3. Forms for cylindrical columns.
4. Form liners.
5. Form ties.
6. Waterstops.
7. Form-release agent.

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

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
  - a. Location of construction joints is subject to approval of the Architect.
3. Indicate location of waterstops.
4. Indicate form liner layout and form line termination details.
5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC308.
- C. Field quality-control reports.
- D. Minutes of preinstallation conference.

#### 1.7 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
  - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
  - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
- B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms 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.

### 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, and as follows:
      - 1) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
      - 2) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
  - 1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class.
  - 1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Form Liners:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Architectural Polymers, Inc.
  - b. Fitzgerald Formliners.
  - c. Sika Corporation.
  - d. Spec Formliners, Inc.
2. Face Pattern: Smooth.

## 2.3 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. 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.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. 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.
- F. 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.
  3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 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.
- D. Construct forms tight enough to prevent loss of concrete mortar.
  - 1. Minimize joints.
  - 2. Exposed Concrete: Symmetrically align joints in forms.
- 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 Architect 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.
- 6. Space vertical joints in walls as indicated on Drawings.
  - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- 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 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.
  - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
  - 5. Clean embedded items immediately prior to concrete placement.

### 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 for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
  2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
1. Align and secure joints to avoid offsets.
  2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.4 SHORING AND RESHORING INSTALLATION

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

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
  2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

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## 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 Sections, 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 the Architect.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
  - 1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M
- 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/A706M.
  - 2. Mechanical splice couplers.
- C. Field quality-control reports.
- D. Minutes of preinstallation conference.

## 1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency 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/D 1.4M.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
  - 1. Store reinforcement to avoid contact with earth.

## PART 2 - PRODUCTS

### 2.1 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- C. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.



## 2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.
  - 1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
    - a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
- C. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; tension-compression type.
- D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
  - 1. Finish: Plain.

## 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. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
  - 2. Stagger splices in accordance with ACI 318.
  - 3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.
  - 4. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, 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."
    - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
  - 2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire.
  - 3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
  - 4. Lace overlaps with wire.

### 3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement.
  - 2. Continue reinforcement across construction joints unless otherwise indicated.
  - 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

### 3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

### 3.5 FIELD QUALITY CONTROL

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

B. Inspections:

1. Steel-reinforcement placement.
2. Steel-reinforcement mechanical splice couplers.
3. Steel-reinforcement welding.

END OF SECTION 032000

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## SECTION 033000 - CAST-IN-PLACE 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:

- 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.

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with fly ash.
- B. Water/Cement Ratio (w/cm): 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 concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Ready-mix concrete manufacturer.
    - d. Concrete Subcontractor.
  - 2. Review the following:
    - a. Special inspection and testing and inspecting agency procedures for field quality control.
    - b. Construction joints, control joints, isolation joints, and joint-filler strips.

- c. Semirigid joint fillers.
- d. Vapor-retarder installation.
- e. Anchor rod and anchorage device installation tolerances.
- f. Cold and hot weather concreting procedures.
- g. Concrete finishes and finishing.
- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- l. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.

## 1.5 ACTION SUBMITTALS

### A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Aggregates.
- 4. Admixtures:
  - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 5. Vapor retarders.
- 6. Floor and slab treatments.
- 7. Liquid floor treatments.
- 8. Curing materials.
- 9. Joint fillers.
- 10. Repair materials.

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

- 1. Mixture identification.
- 2. Minimum 28-day compressive strength.
- 3. Durability exposure class.
- 4. Maximum w/cm.
- 5. Calculated equilibrium unit weight, for lightweight concrete.
- 6. Slump limit.
- 7. Air content.
- 8. Nominal maximum aggregate size.
- 9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
- 10. Intended placement method.

11. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - a. Location of construction joints is subject to approval of the Engineer of Record.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

## 1.6 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. Floor and slab treatments.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.
8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

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

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

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

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.

F. Minutes of preinstallation conference.

1.7 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.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.



## 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. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.
- B. Source Limitations:
  - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
  - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
  - 3. Obtain aggregate from single source.
  - 4. Obtain each type of admixture from single source from single manufacturer.
- C. Cementitious Materials:
  - 1. Portland Cement: ASTM C150/C150M, Type I/II, gray.
  - 2. Fly Ash: ASTM C618, Class C or F.
- D. Normal-Weight Aggregates: ASTM C33/C33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.
  - 1. Alkali-Silica Reaction: Comply with one of the following:
    - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
    - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
    - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.
  - 2. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- E. Air-Entraining Admixture: ASTM C260/C260M.

- F. 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.
1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
  2. Retarding Admixture: ASTM C494/C494M, Type B.
  3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
  5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- G. Water and Water Used to Make Ice: ASTM C94/C94M, potable.

## 2.3 VAPOR RETARDERS

- A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Barrier-Bac; Intoplast Group.
    - b. ISI Building Products.
    - c. Poly-America, L.P.
    - d. Reef Industries, Inc.
    - e. Stego Industries, LLC.
    - f. Tex-Trude.
    - g. W.R. Meadows, Inc.

## 2.4 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. ChemMasters, Inc.
    - c. ChemTec International.
    - d. Concrete Sealers USA.
    - e. Dayton Superior.
    - f. Euclid Chemical Company (The); an RPM company.
    - g. Kaufman Products, Inc.
    - h. Laticrete International, Inc.
    - i. Nox-Crete Products Group.
    - j. PROSOCO, Inc.
    - k. SpecChem, LLC.

- l. US SPEC, Division of US MIX Company.
  - m. Vexcon Chemicals Inc.
  - n. V-Seal Concrete Sealers & Specialty Coatings.
  - o. W.R. Meadows, Inc.
2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. Bon Tool Co.
    - c. ChemMasters, Inc.
    - d. Dayton Superior.
    - e. Euclid Chemical Company (The); an RPM company.
    - f. Kaufman Products, Inc.
    - g. Lambert Corporation.
    - h. Laticrete International, Inc.
    - i. Metalcrete Industries.
    - j. Nox-Crete Products Group.
    - k. Sika Corporation.
    - l. SpecChem, LLC.
    - m. TK Products.
    - n. Vexcon Chemicals Inc.
    - o. W.R. Meadows, Inc.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  1. Color:
    - a. Ambient Temperature Below 50 deg F: Black.
    - b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
    - c. Ambient Temperature Above 85 deg F: White.
- C. Water: Potable or complying with ASTM C1602/C1602M.
- D. Clear, Waterborne, Membrane-Forming, Non-dissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Anti-Hydro International, Inc.
  - b. BASF Corporation.
  - c. ChemMasters, Inc.
  - d. Dayton Superior.
  - e. Euclid Chemical Company (The); an RPM company.
  - f. Kaufman Products, Inc.
  - g. Lambert Corporation.
  - h. Laticrete International, Inc.
  - i. Metalcrete Industries.
  - j. Nox-Crete Products Group.
  - k. SpecChem, LLC.
  - l. TK Products.
  - m. Vexcon Chemicals Inc.
  - n. W.R. Meadows, Inc.
- E. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ChemMasters, Inc.
    - b. Concrete Sealers USA.
    - c. Dayton Superior.
    - d. Euclid Chemical Company (The); an RPM company.
    - e. Kaufman Products, Inc.
    - f. Lambert Corporation.
    - g. Laticrete International, Inc.
    - h. Metalcrete Industries.
    - i. Nox-Crete Products Group.
    - j. Right Pointe.
    - k. SpecChem, LLC.
    - l. TK Products.
    - m. Vexcon Chemicals Inc.
    - n. W.R. Meadows, Inc.
  - 2. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.6 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.
- C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

## 2.7 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
  - 4. Compressive Strength: Not less than 4,100 psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
  - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
  - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
  - 4. Compressive Strength: Not less than 5,000 psi at 28 days when tested in accordance with ASTM C109/C109M.

## 2.8 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
  - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Fly Ash: 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete for parking structure slabs, and concrete with a w/cm below 0.50.

## 2.9 CONCRETE MIXTURES

- A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.
1. Exposure Class: ACI 318 F0, S0, W0, C0.
  2. Minimum Compressive Strength: 3,000 psi at 28 days.
  3. Maximum w/cm: 0.55.
  4. Slump Limit: 4 inches, plus or minus 1 inch, before adding high-range water-reducing or plasticizing admixtures at the Project site (8 inches, plus or minus 1 inch thereafter).
  5. Air Content: 2.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4 inch nominal maximum aggregate size.
  6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- B. Class B: Normal-weight concrete used for foundation walls.
1. Exposure Class: ACI 318 F1, S0, W0, C0.
  2. Minimum Compressive Strength: 4,500 psi at 28 days.
  3. Maximum w/cm: 0.45.
  4. Slump Limit: 4 inches, plus or minus 1 inch, before adding high-range water-reducing or plasticizing admixtures at the Project site (8 inches, plus or minus 1 inch thereafter).
  5. Air Content:
    - a. Exposure Class F1: 5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size.
  6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- C. Class C: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: ACI 318 F0, S0, W0, C0.
  2. Minimum Compressive Strength: 3,000 psi at 28 days.
  3. Maximum w/cm: 0.55.
  4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
  5. Slump Limit: 4 inches, plus or minus 1 inch, before adding high-range water-reducing or plasticizing admixtures at the Project site (8 inches, plus or minus 1 inch thereafter).
  6. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
  7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

## 2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M, and furnish batch ticket information.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

#### A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

#### A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

### 3.3 INSTALLATION OF EMBEDDED ITEMS

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

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

### 3.4 INSTALLATION OF VAPOR RETARDER

#### A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.

5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.
  - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

### 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 the Engineer of Record.
  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. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
  7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- 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.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
  2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.



3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

### 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 of Record and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer of Record in writing, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
  2. Deposit concrete to avoid segregation.
  3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
  4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
    - a. Do not use vibrators to transport concrete inside forms.
    - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.

- d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
  2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  3. Maintain reinforcement in position on chairs during concrete placement.
  4. Screed slab surfaces with a straightedge and strike off to correct elevations.
  5. Level concrete, cut high areas, and fill low areas.
  6. Slope surfaces uniformly to drains where required.
  7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  8. Do not further disturb slab surfaces before starting finishing operations.

### 3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
  - a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
  - b. Remove projections larger than 1 inch.
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 Class D.
  - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/4 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class B.
  - e. Locations: Apply to concrete surfaces as indicated.
3. ACI 301 Surface Finish SF-3.0:
  - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
  - b. Remove projections larger than 1/8 inch.
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class A.
  - e. Locations: Apply to concrete surfaces as indicated.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:

- a. Perform no later than one day after form removal.
  - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
  - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
  - d. Maintain required patterns or variances as shown on Drawings or to match field sample panels.
2. Grout-Cleaned Rubbed Finish:
  - a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
  - b. Do not clean concrete surfaces as Work progresses.
  - c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
  - d. Wet concrete surfaces.
  - e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
  - f. Maintain required patterns or variances as shown on Drawings or to match field sample panels.
3. Cork-Floated Finish:
  - a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
  - b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
  - c. Wet concrete surfaces.
  - d. Compress grout into voids by grinding surface.
  - e. In a swirling motion, finish surface with a cork float.
  - f. Maintain required patterns or variances as shown on Drawings or to match field sample panels.
4. Scrubbed Finish: After concrete has achieved a compressive strength of from 1,000 to 1,500 psi, apply scrubbed finish.
  - a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
  - b. Rinse scrubbed surfaces with clean water.
  - c. Maintain continuity of finish on each surface or area of Work.
  - d. Remove only enough concrete mortar from surfaces to match field sample panels.

C. Related Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.

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

### 3.8 FINISHING FLOORS AND SLABS

- A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
  1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
  2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
  3. Apply scratch finish to surfaces to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.
- C. 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 (ACI A117M) tolerances for conventional concrete.
  3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish:
  1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
  2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
  3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  4. Do not add water to concrete surface.
  5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
  6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
  7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:
    - a. Slabs on Ground:
      - 1) Specified overall values of flatness,  $F_F$  35; and of levelness,  $F_L$  25; with minimum local values of flatness,  $F_F$  24; and of levelness,  $F_L$  17.
    - b. Suspended Slabs:

- 1) Specified overall values of flatness,  $F_F$  35; and of levelness,  $F_L$  20; with minimum local values of flatness,  $F_F$  24; and of levelness,  $F_L$  15. Levelness requirements may be waived for slabs on metal deck.
- E. 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.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
  1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
  2. Coordinate required final finish with Architect before application.

### 3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In:
  1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
  2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
  3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
  1. Coordinate sizes and locations of concrete bases with actual equipment provided.
  2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
  3. Minimum Compressive Strength: As indicated herein.
  4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
  5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
  6. Prior to pouring concrete, place and secure anchorage devices.
    - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    - b. Cast anchor-bolt insert into bases.
    - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

### 3.10 CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
  - 1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
  - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
  - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
  - 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
  - 2. If forms remain during curing period, moist cure after loosening forms.
  - 3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
    - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
      - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
      - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
  - 1. Begin curing immediately after finishing concrete.
  - 2. Interior Concrete Floors:
    - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
      - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
        - a) Lap edges and ends of absorptive cover not less than 12-inches.
        - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
      - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with

- sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
- a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
  - b) Cure for not less than seven days.
- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
- a) Water.
  - b) Continuous water-fog spray.
- b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.
    - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
    - b) Cure for not less than seven days.
  - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - a) Water.
    - b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - a) Lap edges and ends of absorptive cover not less than 12 inches.
    - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

- 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

- a) Water.
- b) Continuous water-fog spray.

d. Floors to Receive Curing Compound:

- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Maintain continuity of coating, and repair damage during curing period.
- 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

e. Floors to Receive Curing and Sealing Compound:

- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
- 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
- 3) Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

### 3.11 TOLERANCES

- A. Conform to ACI 117.

### 3.12 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if surface is rough or porous.

### 3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.



1. Defer joint filling until concrete has aged at least one month.
  2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

### 3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by Architect.
2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
  - a. Limit cut depth to 3/4 inch.
  - b. Make edges of cuts perpendicular to concrete surface.
  - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
  - d. Fill and compact with patching mortar before bonding agent has dried.
  - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
  - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
  - b. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
  - a. Correct low and high areas.

- b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
  2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  3. After concrete has cured at least 14 days, correct high areas by grinding.
  4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
    - a. Finish repaired areas to blend into adjacent concrete.
  5. Correct other low areas scheduled to remain exposed with repair topping.
    - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
    - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
  6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
    - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
    - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
    - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
    - d. Place, compact, and finish to blend with adjacent finished concrete.
    - e. Cure in same manner as adjacent concrete.
  7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
    - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    - b. Dampen cleaned concrete surfaces and apply bonding agent.
    - c. Place patching mortar before bonding agent has dried.
    - d. Compact patching mortar and finish to match adjacent concrete.
    - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

### 3.15 FIELD QUALITY CONTROL

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

- B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
  2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
  3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
    - a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
      - 1) Project name.
      - 2) Name of testing agency.
      - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
      - 4) Name of concrete manufacturer.
      - 5) Date and time of inspection, sampling, and field testing.
      - 6) Date and time of concrete placement.
      - 7) Location in Work of concrete represented by samples.
      - 8) Date and time sample was obtained.
      - 9) Truck and batch ticket numbers.
      - 10) Design compressive strength at 28 days.
      - 11) Concrete mixture designation, proportions, and materials.
      - 12) Field test results.
      - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
      - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
1. Headed bolts and studs.
  2. Verification of use of required design mixture.
  3. Concrete placement, including conveying and depositing.
  4. Curing procedures and maintenance of curing temperature.
  5. Verification of concrete strength before removal of shores and forms from beams and slabs.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
  - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M:
  - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - b. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.
  - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M:
  - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
  - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C31/C31M:
  - a. Cast and laboratory cure two sets of four 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C39/C39M.
  - a. Test one set of two laboratory-cured specimens at seven days and three sets of two specimens at 28 days.
  - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5,000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5,000 psi.

10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
  11. Additional Tests:
    - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer of Record.
    - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer of Record.
      - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301, section 1.6.6.3.
  12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Architect.

### 3.16 PROTECTION

- A. Protect concrete surfaces as follows:
1. Protect from petroleum stains.
  2. Diaper hydraulic equipment used over concrete surfaces.
  3. Prohibit vehicles from interior concrete slabs.
  4. Prohibit use of pipe-cutting machinery over concrete surfaces.
  5. Prohibit placement of steel items on concrete surfaces.
  6. Prohibit use of acids or acidic detergents over concrete surfaces.
  7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

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## SECTION 033503 – WATER VAPOR EMISSION CONTROL

### 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 concrete sealers for the remediation of excessive moisture in concrete slabs. Provide in rooms to receive carpet and/or resilient flooring.

#### 1.3 SYSTEM DESCRIPTION

- A. Provide liquid penetrant concrete sealer and cementitious underlayment to mechanically and chemically reduce water vapor emission and alkalinity from concrete slab to levels acceptable to manufacturer of finish floor covering and adhesive. Work includes preconstruction testing, preparation of slab, application of sealant, and field quality control.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Provide concrete sealer to remediate excessive moisture in floor slab so that moisture-vapor-emission will not exceed 3 lb of water/1000 sq. ft. in 24 hours.
- B. Material Compatibility: Provide vapor emission control system materials that are compatible with one another and finish flooring adhesives under conditions of service and application required, as demonstrated by system manufacturer based on testing and long-term field experience.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.
- B. Qualification Data for Installer and Testing Agency.
- C. Field Quality Control Test Reports.
- D. Special Warranties.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installer that employs workers trained and approved by manufacturer to apply sealers.
- B. Testing Agency Qualifications: An independent testing agency, acceptable to manufacturer, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- C. Manufacturer Qualifications:
  - 1. Minimum 5 years of producing moisture vapor control emission products.
  - 2. Minimum 5 years of product application experience.
  - 3. Employs factory-trained representatives who are available for consultation and Project-site inspection.

4. Warranty program covering costs associated with repair or replacement of concrete vapor emission control system and finish floor covering or coating, including repair or replacement labor.
5. Warranty program covering costs for both system materials and system installation for prescribed vapor emission control system treatment.
- D. Source Limitations: Obtain concrete sealers through one source from a single manufacturer. Product shall be acceptable to manufacturer of finish flooring and adhesive.
- E. Inform manufacturer's technical representative of all concrete additives used in the concrete mix or preparation of the slab.
- F. Test area: Shot blast a test area, as designated by Architect, to evaluate the surface condition and verify that treated area will be acceptable to installer of finish flooring.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original and unopened containers, labeled with type and name of products and manufacturers.
- B. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.

## 1.8 PROJECT CONDITIONS

- A. Environmental Limitations for Sealers: Comply with manufacturer's recommendations for ambient temperature, humidity and condition of slab.
- B. Allow for continuous ventilation and indirect air movement at all times during application and curing process of the water vapor reduction system.

## 1.9 WARRANTY

- A. The manufacturer warrants that when applied according to manufacturer's written recommendations on properly prepared concrete slab as accepted by manufacturer's technical representative the water vapor reduction system will reduce water vapor emissions by 80 percent as indicated by testing by independent testing agency.
  1. Warranty shall not exclude non-conformance to ACI 318, foreign salts, admixtures, resin and silicate surface treatments or cohesive failure in the concrete surface due to normal concrete movement.
- B. Special Warranty: Manufacturer's standard form in which manufacturer warrants water vapor reduction system against defects in material and workmanship within the specified warranty period. Manufacturer agrees to replace floor coverings that fail within specified warranty period due to excessive water vapor emissions through concrete slab. Failures include, but are not limited to, the following:
  1. Adhesives.
  2. Delamination or adhesive failure of floor covering systems, including epoxy and polyurethane resinous flooring systems.
- C. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CONCRETE SEALERS

- A. Sealer: Penetrating sealer recommended by manufacturer for application to interior concrete traffic surfaces for the reduction of excess water vapor emissions from concrete slabs.



- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Koester American Corporation. [www.koesterusa.com](http://www.koesterusa.com).
    - a. VAP 1-2000 for application to green concrete.
    - b. VAP 1 pH for application to cured concrete
  - 2. Terasco
  - 3. Aquafin
- C. Topcoat: Sealing or finish coats.
  - 1. Resin: Epoxy or urethane.
  - 2. Type: Clear.
  - 3. Finish: Matte.
  - 4. Number of Coats: Two.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer and manufacturer's technical representative present, for compliance with requirements for condition of the concrete slab and other conditions affecting performance of water vapor reduction system.
  - 1. Manufacturer's technical representative shall identify number and location of test sites.
  - 2. Perform testing on freshly abraded concrete.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Moisture Testing: Anhydrous calcium chloride test, ASTM F 1869.
  - 1. Maintain temperature and humidity levels expected during normal occupancy or 65 to 85 degrees F and 40 to 60 percent relative humidity for 48 hours before performing test.
- D. Testing for alkalinity and contaminant: Perform tests recommended by manufacturer's technical representative.
- E. Submit results to Architect and manufacturer's technical representative.

### 3.2 PREPARATION

- A. Shot blast concrete slabs and remove all residue and loose material from slab.
- B. Repair defects, cracks, and open surface honeycombs.
- C. Clean concrete as recommended by manufacturer to remove dirt, oils, films, and other materials detrimental to sealer application.
- D. Remove reinforcing fibers from surface.
- E. Protect adjacent construction from overspray or splashing of sealer.

### 3.3 APPLICATION

- A. General: Comply with manufacturer's written instructions and recommendations for application of products, including surface preparation.
- B. Concrete Sealer: Apply by brush, roller, or airless spray at manufacturer's recommended application rate.
- C. Topcoat: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.
- D. Protect sealed concrete slab to prevent damage from active rain or topical water for a period of time recommended by manufacturer.

#### 3.4 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Report findings to Architect and manufacturer's technical representative.
- C. Reapply sealer, if required, to meet performance requirements.

END OF SECTION 033503

## SECTION 054000 - COLD-FORMED METAL FRAMING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Exterior non-load-bearing wall framing.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed steel framing product and accessory.

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.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product test reports.

D. Research reports.

#### 1.4 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

### 2.2 COLD-FORMED STEEL FRAMING, GENERAL

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60, A60, AZ50, or GF30.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
  - 1. Grade: As required by structural performance.
  - 2. Coating: G60.

### 2.3 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: 1-3/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and matching minimum base-metal thickness of steel studs.
- C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
  - 1. Minimum Base-Metal Thickness: 0.0329 inch.
  - 2. Flange Width: 1-3/8 inches.

### 2.4 EXTERIOR 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: 1-3/8 inches.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.
- C. Vertical Deflection Clips: 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.
- E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
- 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.

## 2.5 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration.

## 2.6 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.
- B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by **[hot-dip process according to ASTM A 153/A 153M, Class C]**.
- C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

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

## 2.7 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, with fluid consistency and 30-minute working time.
- D. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.
- E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.
- B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

### 3.2 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 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
- D. Install framing members in one-piece lengths.
- E. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place,

undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

- F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- G. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- I. Erection Tolerances: 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 shall not exceed minimum fastening requirements of sheathing or other finishing materials.

### 3.3 LOAD-BEARING WALL INSTALLATION

- A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:
  - 1. Anchor Spacing: 24 inches.
- B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:
  - 1. Stud Spacing: 16 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.
- D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.
- E. Align floor and roof framing over studs. Where framing cannot be aligned, continuously reinforce track to transfer loads.
- F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.
- G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.
  - 1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.

2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.
- H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.
  1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.
- I. Install horizontal bridging in stud system, spaced vertically 48 inches. Fasten at each stud intersection.
  1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.
  2. 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. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- J. Install steel sheet diagonal bracing straps to both stud flanges, terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.
- K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

### 3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
  1. Stud Spacing: 16 inches.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb 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 bypassing studs and anchor to building structure.
  4. Connect drift clips to cold-formed 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. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of 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.
    - a. Install solid blocking at 96-inch centers.
  2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
  3. 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.
  4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. 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 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. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### 3.6 REPAIRS AND PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

Talbert & Bright: 3105-2401  
The Wilson Group: 2410-000

LBT T-Hangar and 2-Unit Box Hangar  
January 17, 2025

END OF SECTION 054000

## SECTION 055000 - METAL FABRICATIONS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Miscellaneous steel framing and supports.
  - 2. Steel framing and supports for overhead doors.
  - 3. Steel framing and supports for hangar door.
  - 4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
  - 5. Exhaust and supply fan plenum enclosures.
  - 6. Metal bollards.
- B. Products furnished, but not installed, under this Section:
  - 1. Loose steel lintels.
  - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Paint products.
  - 2. Grout.
  - 3. Metal bollards.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
  - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## PART 2 - PRODUCTS

### 2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

### 2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- D. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
  - 1. Size of Channels: 1-5/8 by 1-5/8 inches.
  - 2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B, with G90 coating; 0.108-inch nominal thickness.

### 2.3 NONFERROUS METALS

- A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

### 2.4 FASTENERS

- A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls.
  - 1. Provide stainless-steel fasteners for fastening aluminum.
  - 2. Provide stainless-steel fasteners for fastening stainless steel.
  - 3. Provide stainless-steel fasteners for fastening nickel silver.
  - 4. Provide bronze fasteners for fastening bronze.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

- D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

## 2.5 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches o.c.

## 2.7 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
- C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.
  - 1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 24 inches o.c.
- D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel base plates and top plates as indicated. Drill or punch base plates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

## 2.8 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- C. Galvanize miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

## 2.9 METAL BOLLARDS

- A. Fabricate metal bollards from Schedule 80 steel pipe 1/4-inch wall-thickness rectangular steel tubing. See structural drawings for additional requirements.
- B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch-thick steel plate welded to bottom of sleeve.
- C. Provide paint finish in accordance with Section 099123 "Interior Painting."

## 2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

## 2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

## 2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with primers specified in Section 099123 "Interior Painting" unless zinc-rich primer is indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

### 3.2 INSTALLING METAL BOLLARDS

- A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
- B. Anchor bollards in concrete in formed or core-drilled holes. Fill annular space around bollard solidly with nonshrink, nonmetallic grout.
- C. Fill bollards solidly with concrete, mounding top surface to shed water.

### 3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
- C. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

### 3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000



## SECTION 055133 – METAL LADDERS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Aluminum cage ladder with platform and security door at exterior of hangar building.
- B. Fall protection system.

#### 1.2 RELATED SECTIONS

- A. Section 055000 “Metal Fabrications” for fasteners and installation requirements used to attach ladders to structure.
- B. Section 133419 “Metal Building Systems” for metal building system information.

#### 1.3 REFERENCES

- A. ANSI A14.3 American National Standard for Ladders – Fixed – Safety Requirements.
- B. OSHA 1910.27 U.S. Occupational Safety and Health Administration – Safety Requirements for ladders.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Aluminum cage ladders.
- B. Shop Drawings: Show fabrication and installation details for metal ladder.

1. Include plans, elevations, sections, and details of metal ladder and its connection. Show anchorage and accessory items.
  2. Provide templates for anchors and bolts specified for installation under other Sections.
  3. Provide reaction loads for each hanger and bracket.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Competent and experienced firm capable of selecting fasteners and installing ladders to attain designed operational and structural performance.
- B. Product Qualification: Product design shall comply with OSHA 1910.27 and ANSI A14.3.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

#### 1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions by field measurement before fabrication.
1. Established Dimensions: Where field measurements cannot be made without delaying the Work, indicate established dimensions on shop drawing submittal and proceed with fabrication.

#### 1.9 COORDINATION

- A. Coordinate location of ladder with structural steel components on metal building system.
- B. Coordinate ladder with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak proof, secure, and non-corrosive installation.

#### 1.10 WARRANTY

- A. Manufacturer has responsibility for an extended Corrective Period for work of this Section for a period of 5 years from date of Substantial Completion against all the conditions indicated below, and when notified in writing from Owner, manufacturer shall promptly and without inconvenience and cost to Owner correct said deficiencies.
1. Defects in materials and workmanship.
  2. Deterioration of material and surface performance below minimum OSHA standards as certified by independent third party testing laboratory. Ordinary wear and tear, unusual abuse or neglect excepted.
  3. Within the warranty period, the manufacturer shall, at its option, repair, replace, or refund the purchase price of defective ladder.

- B. Manufacturer shall be notified immediately of defective products, and be given a reasonable opportunity to inspect the goods prior to return. Manufacturer will not assume responsibility, or compensation, for unauthorized repairs or labor. Manufacturer makes no other warranty, expressed or implied, to the merchantability, fitness for a particular purpose, design, sale, installation, or use, of the ladder; and shall not be liable for incidental or consequential damages, losses of or expenses, resulting from the use of ladder products.

## PART 2 - PRODUCTS

### 2.1 METAL LADDERS.

#### A. General:

- 1. Comply with ANSI A14.3 unless otherwise indicated.

#### B. Aluminum Ladders:

- 1. Manufacturers: Subject to compliance with requirements, provide Basis of Design product or product from one of the acceptable alternate manufacturers.
  - a. Basis of Design: Alaco 561-CP with security cage, platform, and security door.
- 2. Alternate Manufacturer: Subject compliance with requirements, the following alternate manufacturers are acceptable.
  - a. Precision Ladders.
  - b. O'Keefe's.
  - c. Strongwell.

#### C. Construction & Materials:

- 1. Aluminum ladders and their components fabricated from 6061-T6 aluminum alloy for added safety, strength and long-lasting durability, with no painting required.
  - a. Aluminum sheet: Alloy 5005-H34 to comply with ASTM B209.
  - b. Aluminum extrusions: Alloy 6063-T6 to comply with ASTM B221.
- 2. Fixed wall ladders with side rails with 1-1/8" (29 mm) round rungs that are serrated and secured with cast aluminum connectors, 4 solid rivets and 3/8" (9.5 mm) thick brackets mounted to the walls.
- 3. Cage consists of 1/4" x 2" (6.4 x 51 mm) hoops and seven 3/16" x 1-1/2" (4.8 x 38 mm) vertical bars, with solid riveted connections.
- 4. Rest Platform "GripStrut" or equal floors, 4" (102 mm) high toe boards, 1-1/4" (32 mm) round serrated tube guard railings and cast aluminum railing fittings.
- 5. Handrails over roof with cage.
- 6. Height- over 30' (9.2 m) installed with cages and rest platforms as indicated on drawings.
- 7. Width- 20-1/4" (514 mm).
- 8. Security door with lock at lower cage or per manufacture's standard details.

#### D. Finishes & Coatings:

- 1. Standard mill finish for aluminum ladders.

### 2.2 LADDER PROTECTION SYSTEM.

#### A. General:

1. Comply with OSHA 1910.27
- B. Ladder Protection System:
  1. Manufacturers: Subject to compliance with requirements, provide Basis of Design product or product from an acceptable alternate manufacturer.
    - a. Basis of Design: LAD-SAF for fixed ladders for two users on the system as manufactured by Fall protection Systems, Florissant MO.
    - b. Or approved equal.
  2. Included cable shuttle and cable guide.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION – GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal ladder. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Methods:
  1. Install top of the top rung, level with top of access/egress level or landing platform, served by the ladder stepping-off surface and space rungs 12" (305 mm) on centers to bottom rung.
  2. Note - Bottom rung height from ground will vary depending on roof height.
  3. Install per complete installation recommendations from the manufacturer.

END OF SECTION 055133

## SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

#### 1.2 PREINSTALLATION MEETINGS

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

#### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Apply AWI Quality Certification or WI Certified Compliance Program label to Shop Drawings.

- C. Samples: For each exposed product and for each color and texture specified.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.

- B. Research reports.

- C. Field quality control reports.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: AWI Quality Certification Program or WI Certified Compliance Program certificates.

## 1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
  - 1. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program or Licensed participant in WI's Certified Compliance Program.
- B. Installer Qualifications: Licensed participant in AWI's Quality Certification Program or Licensed participant in WI's Certified Compliance Program.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to requirements, provide products by Basis-of-Design Manufacturer(s) shown on the Finish Schedule.
- B. Alternate manufacturers, with products deemed equal to the Basis-of-Design Manufacturer, that may be incorporated into the project include:
  - 1. Nevamar.
  - 2. Formica.

### 2.2 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
  - 1. Provide labels and certificates from AWI or WI certification program indicating that woodwork complies with requirements of grades specified.
- B. Architectural Woodwork Standards Grade: Premium.
- C. Type of Construction: Face frame.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- F. Laminate Cladding for Exposed Surfaces:
  - 1. Horizontal Surfaces: Grade HGS.
  - 2. Postformed Surfaces: Grade HGP.
  - 3. Vertical Surfaces: Grade HGS.
  - 4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.

5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  1. As indicated by laminate manufacturer's designations.

## 2.3 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

## 2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction as determined by testing performed on identical products by a qualified testing agency.
  1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
  2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
  3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

## 2.5 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in the Finish Schedule.
- B. 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.
- C. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.
- D. Catches: Magnetic catches, BHMA A156.9, B03141.
- E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- F. Shelf Rests: BHMA A156.9, B04013; metal.
- G. Drawer Slides: BHMA A156.9.
  1. Grade 1 and Grade 2: Side mounted.
    - a. Type: Full extension.
    - b. Material: Zinc-plated steel with polymer rollers.
  2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
  3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
  4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
  5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
  6. For computer keyboard shelves, provide Grade 1.
  7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
- H. Door Locks: BHMA A156.11, E07121.
- I. Drawer Locks: BHMA A156.11, E07041.
- J. Door and Drawer Silencers: BHMA A156.16, L03011.
- K. Grommets for Cable Passage: 1-1/4-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
  1. Color: Architect to select from manufacturer's full range.

## 2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.



1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.7 FABRICATION

- A. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
  1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
  2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

### 3.2 FIELD QUALITY CONTROL

- A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program or WI's Certified Compliance Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
  1. Inspection entity shall prepare and submit report of inspection.

Talbert & Bright: 3105-2401  
The Wilson Group: 2410-000

LBT T-Hangar and 2-Unit Box Hangar  
January 17, 2025

END OF SECTION 064116

## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Glass-fiber blanket (unfaced acoustical batt insulation).

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

### PART 2 - PRODUCTS

#### 2.1 GLASS-FIBER BLANKET

- A. Glass-Fiber Blanket, Unfaced: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.

#### 2.2 ACCESSORIES

- A. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise.

### 3.2 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

END OF SECTION 072100

## SECTION 079200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.

#### 1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Field-adhesion test reports.
- C. Warranties.

#### 1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

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

## 1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: 15 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

### 2.2 SILICONE JOINT SEALANTS

- A. Neutral-Curing Silicone Joint Sealant: ASTM C 920.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. [BASF Building Systems.](#)
    - b. [Dow Corning Corporation.](#)
    - c. [GE Advanced Materials - Silicones.](#)
    - d. [May National Associates, Inc.](#)
    - e. [Pecora Corporation.](#)
    - f. [Polymeric Systems, Inc.](#)
    - g. [Schnee-Morehead, Inc.](#)
    - h. [Sika Corporation; Construction Products Division.](#)
    - i. [Tremco Incorporated.](#)
  - 2. Type: Single component (S).
  - 3. Grade: nonsag (NS).
  - 4. Class: 100/50.

5. Uses Related to Exposure: Nontraffic (NT).

## 2.3 URETHANE JOINT SEALANTS

### A. Urethane Joint Sealant: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. [BASF Building Systems.](#)
  - b. [Bostik, Inc.](#)
  - c. [Lyntal, International, Inc.](#)
  - d. [May National Associates, Inc.](#)
  - e. [Pacific Polymers International, Inc.](#)
  - f. [Pecora Corporation.](#)
  - g. [Polymeric Systems, Inc.](#)
  - h. [Schnee-Morehead, Inc.](#)
  - i. [Sika Corporation; Construction Products Division.](#)
  - j. [Tremco Incorporated.](#)
2. Type: Single component (S).
3. Grade: nonsag (NS).
4. Class: 25.
5. Uses Related to Exposure: Nontraffic (NT).

## 2.4 LATEX JOINT SEALANTS

### A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. [BASF Building Systems.](#)
  - b. [Bostik, Inc.](#)
  - c. [May National Associates, Inc.](#)
  - d. [Pecora Corporation.](#)
  - e. [Schnee-Morehead, Inc.](#)
  - f. [Tremco Incorporated.](#)

## 2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
  - 1. Remove laitance and form-release agents from concrete.
  - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.



- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- F. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
- G. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.3 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
  - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.4 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in apron pavement: Refer to Division 33 section.
- B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation and contraction joints in cast-in-place concrete slabs.
    - b. Exterior joints in apron pavement.
  - 2. Joint Sealant: Urethane.
  - 3. Joint Sealant: Multi-component, non-sag, traffic grade, Class 25.
  - 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
  - 1. Joint Locations:
    - a. Joints between metal panels.
    - b. Perimeter joints between materials listed above and frames of doors, windows and louvers.
  - 2. Joint Sealant: Silicone.
  - 3. Joint Sealant: Single component, non-sag, neutral curing, Class 100/50.
  - 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
  - 1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
  - 2. Joint Sealant: Urethane.
  - 3. Joint Sealant: Multi-component, non-sag, traffic grade, Class 25.
  - 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces.
  - 1. Joint Locations:
    - a. Perimeter joints of exterior openings where indicated.
  - 2. Joint Sealant: Latex.
  - 3. Joint Sealant: Single-component, non-sag, paintable.
  - 4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors paintable.

END OF SECTION 079200

## SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes hollow-metal work.

#### 1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required.
- E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

### PART 2 - PRODUCTS

#### 2.1 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3..
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.

- d. Edge Construction: Model 2, Seamless.
- e. Core: Manufacturer's standard insulation material.
- 3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than R-3 when tested according to ASTM C 1363.
- 4. Frames:
  - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
  - b. Construction: Full profile welded.
- 5. Exposed Finish: Prime.

## 2.2 FRAME ANCHORS

### A. Jamb Anchors:

- 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
- 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
- 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

### B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

- 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

## 2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

## 2.4 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
  1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Compression Type: Not less than two anchors in each frame.
    - b. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.

- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
  - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of hollow-metal work.
  5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

## 2.5 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: SDI A250.10.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - b. Install frames with removable stops located on secure side of opening.
    - c. Install door silencers in frames before grouting.
    - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.

- e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  - 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
  - B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
    - 1. Non-Fire-Rated Steel Doors:
      - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
      - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
      - c. At Bottom of Door: **[3/4 inch]** **[5/8 inch]** plus or minus 1/32 inch.
      - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
  - C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
    - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.
- 3.2 ADJUSTING AND CLEANING
- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
  - B. Remove grout and other bonding material from hollow-metal work immediately after installation.
  - C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

- D.    Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E.    Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113



## SECTION 081416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door louvers.
5. Factory-machining criteria.
6. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Apply WI Certified Compliance Program label to Shop Drawings.

C. Samples: For factory-finished doors.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Quality Standard Compliance Certificates: WI Certified Compliance Program certificates.
- B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer's Certification: Licensed participant in WI's Certified Compliance Program.
- B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
  - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.
- C. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
  - 1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Wood Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

#### 2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.
  - 1. Provide labels and certificates from WI certification program indicating that doors comply with requirements of grades specified.
    - a. This project has been registered with AWI as AWI Quality Certification Program Number.
    - b. Contractor shall register the Work under this Section with the AWI Quality Certification Program at [www.awiqcp.org](http://www.awiqcp.org) or by calling 855-345-0991.

2.3 SOLID-CORE, FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR  
TRANSPARENT FINISH

A. Interior Doors:

1. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
2. Performance Grade:
  - a. ANSI/WDMA I.S. 1A Extra Heavy Duty.
3. Architectural Woodwork Standards ANSI/WDMA I.S. 1A Grade: Premium.
4. Faces: Single-ply wood veneer not less than 1/50 inch thick.
  - a. Species: Select white birch.
  - b. Cut: Rotary cut.
  - c. Match between Veneer Leaves: Book match.
  - d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
  - e. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
  - f. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 064216 "Flush Wood Paneling."
5. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.
  - a. Fire-Rated Single Doors: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed vertical edges.
  - b. At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
    - 1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.
6. Core for Non-Fire-Rated Doors:
  - a. ANSI A208.1, Grade LD-1 particleboard.
    - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
      - a) 5-inch top-rail blocking, in doors indicated to have closers.
      - b) 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
      - c) 5-inch midrail blocking, in doors indicated to have exit devices.
    - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."

- b. Glued wood stave.
  - c. WDMA I.S. 10 structural composite lumber.
    - 1) Screw Withdrawal, Face: 550 lbf.
    - 2) Screw Withdrawal, Edge: 550 lbf 475 lb.
  - d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.
7. Core for Fire-Rated Doors: As required to achieve fire-protection rating indicated on Drawings.
- a. Blocking for Mineral-Core Doors: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated on Drawings as needed to eliminate through-bolting hardware.
8. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

## 2.4 LIGHT FRAMES AND LOUVERS

- A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
  - 1. Wood Species: Same species as door faces.
  - 2. Profile: Flush rectangular beads.
  - 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; factory primed for paint finish; and approved for use in doors of fire-protection rating indicated on Drawings.
- D. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.
  - 1. Wood Species: Same species as door faces.
  - 2. Profile: Flat.
- E. Metal Louvers:
  - 1. Blade Type: Vision-proof, inverted V.
  - 2. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.
  - 3. Metal and Finish: Extruded aluminum with Class II, clear anodic finish, AA-M12C22A31.
  - 4. Metal and Finish: Extruded aluminum with black, Class II, color anodic finish, AA-M12C22A32/A34.

- F. Louvers for Fire-Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire-protection rating of 1-1/2 hours and less.
  - 1. Metal and Finish: Hot-dip galvanized steel, 0.040 inch thick, factory primed for paint finish.

## 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
  - 1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  - 2. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
  - 1. Locate hardware to comply with DHI-WDHS-3.
  - 2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
  - 3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
  - 4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
  - 5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
- C. Openings: Factory cut and trim openings through doors.
  - 1. Light Openings: Trim openings with moldings of material and profile indicated.
  - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
  - 3. Louvers: Factory install louvers in prepared openings.
- D. Exterior Doors: Factory treat exterior doors with water repellent after fabrication has been completed but before factory finishing.
  - 1. Flash top of outswinging doors with manufacturer's standard metal flashing.

## 2.6 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
  - 1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  - 2. Finish faces, all four edges, edges of cutouts, and mortises.
  - 3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:

1. Architectural Woodwork Standards ANSI/WDMA I.S. 1A Grade: Premium.
2. Finish: Architectural Woodwork Standards System-5, Varnish, Conversion.
3. Staining: As selected by Architect from manufacturer's full range.
4. Effect: Open-grain finish.
5. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
  1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
  2. Anchor frames to anchors or blocking built in or directly attached to substrates.
    - a. Secure with countersunk, concealed fasteners and blind nailing.
    - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
      - 1) For factory-finished items, use filler matching finish of items being installed.
  3. Install fire-rated doors and frames in accordance with NFPA 80.
  4. Install smoke- and draft-control doors in accordance with NFPA 105.
- D. Job-Fitted Doors:
  1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
    - a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.
  2. Machine doors for hardware.
  3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  4. Clearances:
    - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    - c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
    - d. Comply with NFPA 80 for fire-rated doors.
  5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.

6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### 3.2 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
  1. Provide inspection of installed Work through WI's Certified Compliance Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
  2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
  3. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

### 3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

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## SECTION 083113 - ACCESS DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes access doors and frames for walls and ceilings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type of access door and frame and for each finish specified.
- C. Product Schedule: For access doors and frames.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

### PART 2 - PRODUCTS

#### 2.1 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Exposed Flanges.
  - 1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
  - 2. Locations: Wall.
  - 3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
  - 4. Frame Material: Same material, thickness, and finish as door.
  - 5. Latch and Lock: Cam latch, key operated.

#### 2.2 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

## 2.3 FABRICATION

- A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- C. Latch and Lock Hardware:
  - 1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
  - 2. Keys: Furnish two keys per lock and key all locks alike.

## 2.4 FINISHES

- A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Adjust doors and hardware, after installation, for proper operation.

### 3.2 FIELD QUALITY CONTROL

- A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

END OF SECTION 083113

## SECTION 083620 – HYDRAULIC HANGAR DOORS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Electrically operated, one-piece hydraulic hangar door. Door consists of door jambs, cam units, truss, push blocks, bearing assembly and is jig welded at factory. Includes hydraulic cylinders, electric hydraulic power unit, electrical controls, stainless steel hydraulic lines, hydraulic hoses and weather seals. All steel is prime painted with the manufacturer's standard structural primer.

B. Items Furnished but not Installed Under This Section:

1. Preparation of the metal building to receive the hangar door, field wiring, field finish paint, metal sheeting, and insulation.

#### 1.2 RELATED SECTIONS

- A. Section 01300 Alternates.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design hydraulic hangar doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

- B. Structural Performance: Provide hydraulic hangar door capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

1. Wind Load: Exterior and interior wind load pressure indicated on Drawings.
2. Door Deflection Limits: Withstand test pressures of 100 percent of inward and outward wind-load design pressures with maximum deflection of 1/180 of the span with no evidence of failure.
3. Structural Deflection: Design hydraulic hangar door as a system to withstand the upward and downward deflections of the cantilevered structure supporting and bracing the top of the hangar door system in all positions with the proper lateral bracing.
  - a. Positive deflection (wind uplift) – As indicated on approved Metal Building System shop drawings.
  - b. Negative deflection (live load) – As indicated on approved Metal Building System shop drawings.
4. Door Operation Under Wind Load: Design operating system to remain operable up to a wind load of 5 psf minimum.
5. Design and size of the components to withstand dead and live loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with Code to a design pressure to meet design criteria of building.

- C. Seismic Performance: Comply with ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads".

#### 1.4 SUBMITTALS

- A. Product Data: For hydraulic door and operators.
  - 1. Construction details, material descriptions, dimensions of individual components, profiles for framing members, and finishes.
  - 2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
  - 3. Shop primer.
- B. Shop Drawings: Prepared by manufacturer. Include elevations showing hydraulic hangar door, and details of each condition of installation and attachment. Indicate coordination dimensions related to structural support system elements and panel cladding materials provided by others. Summary of forces and loads imposed on walls by sliding doors.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
  - 3. Include structural calculations that demonstrate compliance with project performance requirements, prepared and signed by the responsible professional engineer, licensed in project state.
- C. Qualification Data: For Manufacturer/Installer and professional engineer.
- D. Welding Certificates.
- E. Operation and Maintenance Data: For hydraulic hangar door to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer: Experienced fabricator and installer of hangar doors similar in size, construction, and operation to those specified, with a minimum of 5 year record of successful performance.
  - 1. Service Proximity: Manufacturer must have qualified service personnel available to provide emergency service within 4 hours travel time.
- B. Source Limitations: Obtain hydraulic hangar door, operators, and controls through one source from a single manufacturer.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
  - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."

- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## 1.6 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages and steel weld plates and angles for casting into concrete. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Indicate measurements on Shop Drawings.

## 1.8 WARRANTY

- A. Special Manufacturer's Warranty: Provide manufacturer's standard limited warranty form indicating manufacturer's agreement to repair or replace hydraulic hangar doors supplied by the manufacturer that fail in materials and workmanship within two years of date of Substantial Completion. Provide manufacturer's standard limited warranty form indicating manufacturer's agreement to repair or replace hydraulic hangar door motors and pumps supplied by the manufacturer that fail in materials and workmanship within seven years of date of Substantial Completion.
- B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Hangar Door and Operators: Provide products from one of the following:
  - 1. "Hydraulic Hangar Doors", Schweiss Doors, 72121 470<sup>th</sup> Street, Hector, MN 55342, (507) 426-8273.
  - 2. "Higher Quality No-Fold Hydraulic Doors", Hi-Fold Door Corporation, N6170 1070<sup>th</sup> Street, River Falls, WI 54022, (800) 443-6536.
  - 3. "Hydraulic Aircraft Hangar Doors", PowerLift Hydraulic Doors, 1482 200<sup>th</sup> Avenue, Lake Benton, MN 56149, (855) 368-9595.
  - 4. "Hydra-Tilt", Well-Bilt Industries, 3006 Southwest 67<sup>th</sup> Ave., Ocala, FL 34474, (352) 528-5566."

- B. Provide products from a singular manufacturer.
- C. Provide manufacturer's standard battery backup system.
- D. Provide manufacturer's standard remove operator system and/or wireless remote operator system.
- E. Include in bid price type and quantity of manufacturer's recommendation for hydraulic fluid to operator door.

## 2.2 PREFERRED BRAND ALTERNATE #3.

- A. Preferred Brand Alternate #3 – Alternate No. 3 shall apply to the Hydraulic Hangar Doors specified under this specification as follows: Under base bid provide Hydraulic Hangar Doors as shown on drawings and as specified under Part 2.1 of this specification. Under Preferred Brand Alternate No. 3, provide s Hydraulic Hangar Doors as shown on drawings and as specified under Part 2.2 of this specification.
- B. Lumberton Regional Airport Preferred Brand Alternate Hydraulic Hangar Door Specification.
  - 1. In accordance with North Carolina General Statute GS 133-3, Specifications may list one or more preferred brands as an alternate to the base bid in limited circumstances. Specifications containing a preferred brand alternate under this section must identify the performance standards that support the preference. Performance standards for the preference must be approved in advance by the owner in an open meeting. Any alternate approved by the owner shall be approved only where (i) the preferred alternate will provide cost savings, maintain or improve the functioning of any process or system affected by the preferred item or items, or both, and (ii) a justification identifying these criteria is made available in writing to the public. For the purpose of this Project, the Owner has selected the following preferred brand alternate(s):
    - a. Implementation of this Preferred Brand Alternate maintains and improves the functioning and maintenance of system/process affected by the preference.
    - b. The performance standards of the preferred brand alternate(s) described above will be deemed approved by the Owner at the pre-construction meeting for this Project.
    - c. Provide product from: "Higher Power Hydraulic Door", Higher Power Hydraulic Doors, 1400 Territorial Road, Benton Harbor, MI 49022, (269) 927-8990. (AD-01)

## 2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
  - 1. Grade: ST50H.
  - 2. Coating: G90.
- D. Door Jamb Columns: I-Beam as required by design loads.

- E. Head, jamb and sill weather seals are flap type sheet rubber. All weather seals shall be retained with full length steel binding strips attached with rust resistant fasteners.
- F. Hydraulic Cylinder: 2 hydraulic cylinders that exceed the anticipated door loads, complete with safety components to prevent the door from falling if a hydraulic failure occurs.
- G. Hardware and Fasteners: Provide Type 316 stainless-steel fasteners. Select fasteners for type, grade, and class required.
- H. Shop Primers: Provide primers that comply with Division 09 Section "Interior Painting requirements for field-applied paint.

## 2.4 ELECTRIC OPERATOR

- A. Electrical wiring: Furnished completely, factory installed wired motor, wired for 240V single phase.

## 2.5 ELECTRIC CONTROLS

- A. Electrical components placed next to the door opening in a location to meet the requirements of N.E.C. section 513. NEMA type 1: "open-close-stop" push button control wired for 24 volts standard. Wired to require constant pressure for door to raise and lower.
- B. All electrical wiring from the electric motor operator internal to the push button control shall be factory wired.

## 2.6 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches o.c.

## 2.7 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Preparation for Shop Priming: Prepare surfaces to comply with SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
  - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## PART 3 - EXECUTION

### 3.1 DELIVERY, STORAGE AND HANDLING

- A. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water, so as to permit access for inspection and handling.
- B. Handle materials carefully to prevent damage.

### 3.2 EXAMINATION

- A. Examine concrete slab under door to confirm that floor slab meets tolerance requirements for the full length of door.
- B. Examine framing, supports, and bracing for track assembly and area behind door to confirm that conditions are acceptable.
- C. Verify conditions are acceptable before starting work. Proceed with installation only after unsatisfactory conditions have been corrected. Building header and jamb columns must be flush.
- D. Verify that wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- E. Verify that electrical power is available and of the correct characteristics.

### 3.3 INSTALLATION

- A. Install door unit assembly in accordance with manufacturers' instructions.
- B. Anchor assembly to floor and building frame without distortion or stress.
- C. Fit and align door assembly including hardware.
- D. Coordinate installation of electrical service. Complete power and control wiring from electrical controls to main building power.



- E. Install perimeter trim, closures and weather stripping.

### 3.4 ADJUSTING AND CLEANING

- A. Inspection of the doors and complete operating test will be made by the installer in the presence of the General Contractor and/or Architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the General Contractor must assume the responsibility for any damage or rough handling of the door during construction until the building is turned over to the owner and final inspection is made.
- B. Check moving parts for proper alignment and lubrication. Make adjustments for smooth, easy operation.
  - 1. Inspect weatherstripping using backlighting to ensure that no visible gaps are noted. Adjust weatherstripping units to eliminate visible gaps.
- C. Clean surfaces and repaint abraded or damaged primed surfaces to match factory-applied finish.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's personnel to operate hangar doors.

END OF SECTION 083620

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## SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Storefront framing.

#### 1.2 PREINSTALLATION MEETINGS

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

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
2. Include point-to-point wiring diagrams.

- C. Samples: For each type of exposed finish required.

- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

- E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

- B. Product test reports.

- C. Source quality-control reports.

- D. Field quality-control reports.

- E. Sample warranties.

## 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated.
- C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

## 1.7 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.
- B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  - 2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.

- d. Loosening or weakening of fasteners, attachments, and other components.
  - e. Failure of operating units.
- C. Structural Loads:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: In accordance with local codes..
- D. Deflection of Framing Members: At design wind pressure, as follows:
  - 1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  - 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
  - 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
    - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans of less than 11 feet 8-1/4 inches.
- E. Structural: Test according to ASTM E330/E330M as follows:
  - 1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- F. Air Infiltration: Test according to ASTM E283 for infiltration as follows:
  - 1. Fixed Framing and Glass Area:
    - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
- G. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:
  - 1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
- H. Energy Performance: Certify and label energy performance according to NFRC as follows:
  - 1. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system shall have U-factor of not more than 0.41 Btu/sq. ft. x h x deg F as determined according to NFRC 100.

2. Solar Heat Gain Coefficient (SHGC): Fixed glazing and framing areas as a system shall have SHGC of no greater than 0.26 as determined according to NFRC 200.
  3. Condensation Resistance: Fixed glazing and framing areas as a system shall have an NFRC-certified condensation resistance rating of no less than 15 as determined according to NFRC 500.
- I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 STOREFRONT SYSTEMS

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Exterior Framing Construction: Thermally broken.
  2. Glazing System: Retained mechanically with gaskets on four sides.
  3. Finish: Clear anodic finish.
  4. Fabrication Method: Field-fabricated stick system.
  5. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  6. Steel Reinforcement: As required by manufacturer.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

## 2.3 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

## 2.4 MATERIALS

- A. Sheet and Plate: ASTM B209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
- C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.
- D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.5 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
  2. Accurately fitted joints with ends coped or mitered.
  3. Physical and thermal isolation of glazing from framing members.
  4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  5. Provisions for field replacement of glazing from exterior and interior for vision glass,
  6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.6 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
1. Color and Gloss: Match existing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

### 3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
  - a. Perform a minimum of two tests in areas as directed by Architect.
2. Air Infiltration: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..
  - a. Perform a minimum of two tests in areas as directed by Architect.
3. Water Penetration: ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.



- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

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## SECTION 087100 – DOOR HARDWARE

### PART 1 - GENERAL

#### 1.01 SUMMARY

A. Section includes:

1. Mechanical door hardware
2. Door position switches for connection to electronic security system.

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
  - a. "Metal Doors and Frames"
  - b. "Flush Wood Doors"
  - c. "Interior Aluminum Doors and Frames"
  - d. "Aluminum-Framed Entrances and Storefronts"
  - e. "Special Function Doors"
  - f. "Entrances"
6. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
7. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
8. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

#### 1.02 REFERENCES

A. UL, LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies

4. UL 305 - Panic Hardware
- B. DHI - Door and Hardware Institute
1. Sequence and Format for the Hardware Schedule
  2. Recommended Locations for Builders Hardware
  3. Keying Systems and Nomenclature
  4. Installation Guide for Doors and Hardware
- C. NFPA – National Fire Protection Association
1. NFPA 70 – National Electric Code
  2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
  3. NFPA 101 – Life Safety Code
  4. NFPA 105 – Smoke and Draft Control Door Assemblies
  5. NFPA 252 – Fire Tests of Door Assemblies
- D. ANSI - American National Standards Institute
1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
  2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
  3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
  4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
  5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

### 1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
  - a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
  - b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
  - c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

- a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

3. Door Hardware Schedule:

- a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
- b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
- c. Indicate complete designations of each item required for each opening, include:
  - 1) Door Index: door number, heading number, and Architect's hardware set number.
  - 2) Quantity, type, style, function, size, and finish of each hardware item.
  - 3) Name and manufacturer of each item.
  - 4) Fastenings and other pertinent information.
  - 5) Location of each hardware set cross-referenced to indications on Drawings.
  - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
  - 7) Mounting locations for hardware.
  - 8) Door and frame sizes and materials.
  - 9) Degree of door swing and handing.

4. Key Schedule:

- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
- b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
- c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
- d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
- e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
- f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

- 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
- 2. Provide Product Data:
  - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

- b. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
  - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
  - b. Catalog pages for each product.
  - c. Final approved hardware schedule edited to reflect conditions as installed.
  - d. Final keying schedule
  - e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
  - a. fire door assemblies, in compliance with NFPA 80.
  - b. required egress door assemblies, in compliance with NFPA 101.

#### 1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
  - a. For door hardware: DHI certified AHC or DHC.
  - b. Can provide installation and technical data to Architect and other related subcontractors.
  - c. Can inspect and verify components are in working order upon completion of installation.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Fire-Rated Door Openings:

- a. Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction.
- b. Provide only items of door hardware that are listed products tested by UL LLC, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

2. Accessibility Requirements:

- a. Comply with governing accessibility regulations cited in “REFERENCES” article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
  - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
  - 2) Preliminary key system schematic diagram.
  - 3) Requirements for key control system.
  - 4) Address for delivery of keys.

2. Pre-installation Conference

- a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- b. Inspect and discuss preparatory work performed by other trades.
- c. Review required testing, inspecting, and certifying procedures.
- d. Review questions or concerns related to proper installation and adjustment of door hardware.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

#### 1.06 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- C. Electrical System Roughing-In: Coordinate layout and installation of door position switches with connections to building safety and security systems.

#### 1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
  - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
  - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    - a. Mechanical Warranty
      - 1) Locks
        - a) 3 years
      - 2) Exit Devices
        - a) 3 years
      - 3) Closers
        - a) 30 years

#### 1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.



## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.
- B. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect’s approval.

### 2.02 MATERIALS

- A. Fabrication
  - 1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
  - 2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
  - 3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Aluminum Storefront” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
  - 1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

### 2.03 HINGES

- A. Manufacturers and Products:
  - 1. Scheduled Manufacturer and Product:
    - a. Ives 5BB series
  - 2. Acceptable Manufacturers and Products:
    - a. Hager BB1191/1279 series
    - b. Stanley FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. Provide hinge weights and sizes as specified in hardware sets.
4. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
  - a. Steel Hinges: Steel pins
  - b. Non-Ferrous Hinges: Stainless steel pins
  - c. Out-Swinging Exterior Doors: Non-removable pins
  - d. Out-Swinging Interior Lockable Doors: Non-removable pins
  - e. Interior Non-lockable Doors: Non-rising pins

## 2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Select
  - b. ABH

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide hinge weights and sizes as specified in hardware sets.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

## 2.05 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:

- a. Ives
- 2. Acceptable Manufacturers:
  - a. Burns
  - b. DCI
- B. Requirements:
  - 1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

## 2.06 COORDINATORS

- A. Manufacturers:
  - 1. Scheduled Manufacturer:
    - a. Ives
  - 2. Acceptable Manufacturers:
    - a. Burns
    - b. DCI
- B. Requirements:
  - 1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
  - 2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

## 2.07 MORTISE LOCKS

- A. Manufacturers and Products:
  - 1. Scheduled Manufacturer and Product:
    - a. Schlage L9000 series
- B. Requirements:
  - 1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.

2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
  - a. Lever Design: 07A.

## 2.08 NARROW STILE DEADLOCK/DEADLATCH

### A. Manufacturers and Products:

1. Scheduled Manufacturer:
  - a. Adams Rite
2. Acceptable Manufacturers:
  - a. C.R. Laurence
  - b. General Lock

### B. Requirements:

1. Provide narrow style aluminum door deadlocks/deadlatches.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide manufacturer's standard strikes unless extended lip strikes are necessary to protect trim.

## 2.09 EXIT DEVICES

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Von Duprin 98/35A series

### B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.

3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
15. Special Options:
  - a. Concealed Vertical Cable Exit Devices: provide cable-actuated concealed vertical latch system in two-point for non-rated or fire rated wood doors up to a 90 minute rating and less bottom latch (LBL) configuration for non-rated or fire rated wood doors up to 20 minute rating. Vertical rods not permitted.
    - 1) Cable: Stainless steel with abrasive resistant coating. Conduit and core wire ends snap into latch and center slides without use of tools.
    - 2) Latchbolts and Blocking Cams: Manufactured from sintered metal low carbon copper- infiltrated steel, with molybdenum disulfide low friction coating.
    - 3) Top Latchbolt: Minimum 0.38 inch (10 mm) and greater than 90 degree engagement with strike to prevent door and frame separation under high static load.
    - 4) Bottom Latchbolt: Minimum of 0.44-inch (11 mm) engagement with strike.
    - 5) Product Cycle Life: 1,000,000 cycles.
    - 6) Latch Operation: Top and bottom latch operate independently of each other. Top latch fully engages top strike even when bottom latch is compromised. Separate trigger mechanisms not permitted.
    - 7) Latch release does not require separate trigger mechanism.
    - 8) Cable and latching system characteristics:
      - a) Installed independently of exit device installation, and capable of functioning on door prior to device and trim installation.
      - b) Connected to exit device at single point in steel and aluminum doors, and two points for top and bottom latches in wood doors.
      - c) Bottom latch height adjusted, from single point for steel and aluminum doors and two points for wood doors, after system is installed and connected to exit device, while door is hanging

- d) Bottom latch position altered up and down minimum of 2 inches (51 mm) in steel and aluminum doors without additional adjustment.
- e) Top and bottom latches in steel and aluminum doors may be removed while door is hanging.

## 2.10 CYLINDERS

### A. Manufacturers and Products:

#### 1. Scheduled Manufacturer and Product:

- a. Schlage Everest 29 T

### B. Requirements:

- 1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
- 2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
  - a. Conventional Patented Restricted: cylinder with interchangeable core with patented, restricted keyway.
- 3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
- 4. Nickel silver bottom pins.

## 2.11 KEYING

### A. Scheduled System:

#### 1. New factory registered system:

- a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

### B. Requirements:

#### 1. Construction Keying:

- a. Replaceable Construction Cores.
  - 1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
    - a) 3 construction control keys
    - b) 10 construction change (day) keys.
  - 2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.

#### 2. Permanent Keying:

- a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
  - 1) Master Keying system as directed by the Owner.
- b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
- c. Provide keys with the following features:
  - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
  - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
- d. Identification:
  - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
  - 2) Identification stamping provisions must be approved by the Architect and Owner.
  - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
  - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
  - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- e. Quantity: Furnish in the following quantities.
  - 1) Change (Day) Keys: 3 per cylinder/core.
  - 2) Permanent Control Keys: 3.
  - 3) Master Keys: 6.

## 2.12 KEY CONTROL SYSTEM

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Telkee
2. Acceptable Manufacturers:
  - a. HPC
  - b. Lund

### B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
  - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
  - b. Provide hinged-panel type cabinet for wall mounting.

## 2.13 DOOR CLOSERS

### A. Manufacturers and Products:

#### 1. Scheduled Manufacturer and Product:

- a. LCN 4040XP series

### B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

## 2.14 DOOR TRIM

### A. Manufacturers:

#### 1. Scheduled Manufacturer:

- a. Ives

#### 2. Acceptable Manufacturers:

- a. Trimco
- b. Burns

### B. Requirements:



1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

## 2.15 PROTECTION PLATES

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

### B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Provide protection plates with countersunk screw holes.
3. Size plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
4. At fire rated doors, provide protection plates over 16 inches high with UL label.

## 2.16 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturers:
  - a. Glynn-Johnson
2. Acceptable Manufacturers:
  - a. Rixson
  - b. ABH

### B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

## 2.17 DOOR STOPS AND HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturer:

- a. Ives
- 2. Acceptable Manufacturers:
  - a. Trimco
  - b. Burns
- B. Provide door stops at each door leaf:
  - 1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
  - 2. Where a wall stop cannot be used, provide overhead stop.
  - 3. Where wall or overhead stop cannot be used, provide floor stop.
  - 4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

## 2.18 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

### A. Manufacturers:

- 1. Scheduled Manufacturer:
  - a. Zero International
- 2. Acceptable Manufacturers:
  - a. National Guard
  - b. Reese

### B. Requirements:

- 1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
- 2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
- 3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
- 4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

## 2.19 SILENCERS

### A. Manufacturers:

- 1. Scheduled Manufacturer:
  - a. Ives
- 2. Acceptable Manufacturers:

- a. Steelcraft
- b. Republic

B. Requirements:

- 1. Provide "push-in" type silencers for hollow metal or wood frames.
- 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
- 3. Omit where gasketing is specified.

## 2.20 DOOR POSITION SWITCHES

A. Manufacturers:

- 1. Scheduled Manufacturer:
  - a. Schlage
- 2. Acceptable Manufacturers:
  - a. GE-Interlogix
  - b. Sentrol

B. Requirements:

- 1. Provide recessed or surface mounted type door position switches as specified.
- 2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

## 2.21 COAT HOOKS

A. Manufacturers:

- 1. Scheduled Manufacturer:
  - a. Ives
- 2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

B. Provide coat hooks as specified.

## 2.22 FINISHES

- A. Finish: Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
  - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
  2. Replace construction cores with permanent cores as indicated in keying section.
  3. Furnish permanent cores to Owner for installation.
- J. **OPTION:** Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
1. Conduit, junction boxes and wire pulls.
  2. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

### 3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.

- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

### 3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

#### **HARDWARE GROUP NO. 01**

Doors: 101A, 121A

Provide each RU door(s) with the following:

<u>QTY</u>	<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
	HARDWARE BY DOOR SUPPLIER	HARDWARE BY DOOR SUPPLIER		

#### **HARDWARE GROUP NO. 02**

Doors: 101B, 101C, 121B, 121C

Provide each SGL door(s) with the following:

<u>QTY</u>	<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA PANIC HARDWARE	CD-98-NL	626	VON
1	EA RIM CYLINDER	20-022	626	SCH
1	EA MORTISE CYLINDER	30-001 X L583-474 118 EV C 36-083	626	SCH
1	EA LATCH GUARD	LG1	630	IVE
1	EA SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA GASKETING	429AA-S	AA	ZER
1	EA DOOR SWEEP	39A	A	ZER
1	EA THRESHOLD	655A-223-36" (914MM)	A	ZER
1	EA RAIN DRIP	142A	A	ZER
1	EA DOOR CONTACT	679-05HM	BLK	SCE

### HARDWARE GROUP NO. 03

Doors: 106A, 126A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	ND80P6D SPA	626	SCH
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223-36" (914MM)	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

### HARDWARE GROUP NO. 04

Doors: 105A, 125A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
1	EA	CONT. HINGE	224XY	628	IVE
1	EA	DEADBOLT	MS1950	628	ADA
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	MORTISE CYLINDER	30-138 ICX 36-083	626	SCH
1	EA	CYLINDER THUMBTURN	ADA MORTISE	628	ADA
1	EA	FSIC CORE	23-030 EV29 T	626	SCH
1	EA	PUSH/PULL BAR	9190HD-10"-NO	630	IVE
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	OH STOP	100S	630	GLY
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223-36" (914MM)	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

### HARDWARE GROUP NO. 05

Doors: 106B, 126B

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
2	EA	CONT. HINGE	224XY	628	IVE
1	EA	3-POINT DEADBOLT	MS1950 x 4015 x 4016	628	ADA
2	EA	MORTISE CYLINDER	30-138 ICX 36-083	626	SCH
2	EA	FSIC CORE	23-030 EV29 T	626	SCH
2	EA	PUSH/PULL BAR	9190EZHD-10"-NS	US32D-316	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH WMS	689	LCN
1		SEALS BY DOOR SUPPLIER			

#### **HARDWARE GROUP NO. 06**

Doors: 108A, 128A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080T 07A	626	SCH
1	EA	FSIC CORE	23-030 EV29 T	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER

#### **HARDWARE GROUP NO. 07**

Doors: 107A, 114A, 116A, 127A, 139A, 140A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM LOCK	L9080T 07A	626	SCH
1	EA	FSIC CORE	23-030 EV29 T	626	SCH
1	EA	OH STOP	450S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

#### **HARDWARE GROUP NO. 08**

Doors: 112A, 113A, 132A, 133A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 07A 09-544	626	SCH
1	EA	FSIC CORE	23-030 EV29 T	626	SCH
1	EA	COAT AND HAT HOOK	507	626	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

#### **HARDWARE GROUP NO. 09**

Doors: 111A, 131A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE SET	L9010 07A	626	SCH
1	EA	WALL STOP	WS406/407CVX	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

#### **HARDWARE GROUP NO. 10**

Doors: 109A, 129A

Provide each SGL door(s) with the following:



<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK WITH INDICATOR ON EXT.	L9040 07A 09-544 L283-722	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	SINGLE HOOK	507B	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

#### **HARDWARE GROUP NO. 11**

Doors: 110A, 130A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	PASSAGE SET	L9010 07A	626	SCH
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

#### **HARDWARE GROUP NO. 12**

Doors: 115A, 141A

Provide each SGL door(s) with the following:

<u>QTY</u>		<u>DESCRIPTION</u>	<u>CATALOG NUMBER</u>	<u>FINISH</u>	<u>MFR</u>
6	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	EA	FLUSHBOLT	FB458-12"	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 07A	626	SCH
1	EA	FSIC CORE	23-030 EV29 T	626	SCH
2	EA	SURFACE CLOSER	4040XP CUSH WMS	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	SET	GASKETING	488SBK PSA 6070	BK	ZER
1	EA	MEETING STILE	383AA 84"	AA	ZER

END OF SECTION

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## SECTION 088000 - GLAZING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - 1. Doors.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design glass, including comprehensive engineering analysis according to the 2012 NC Building Code by a qualified professional engineer, using the following design criteria:
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Design Snow Loads: As indicated on Drawings.
  - 3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
    - a. Outward design wind pressure minus the weight of the glass. Base design on glass type factors for short-duration load.
    - b. Inward design wind pressure plus the weight of the glass plus half of the design snow load. Base design on glass type factors for short-duration load.
    - c. Half of the inward design wind pressure plus the weight of the glass plus the design snow load. Base design on glass type factors for long-duration load.

#### 1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Preconstruction adhesion and compatibility test report.

## 1.6 QUALITY ASSURANCE

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC the SGCC or another certification agency acceptable to authorities having jurisdiction or the manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

## 1.7 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  - 2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  - 3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

### 2.2 INSULATING GLASS

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
  - 1. Sealing System: Dual seal.
  - 2. Spacer: Manufacturer's standard spacer material and construction Thermally broken aluminum.

### 2.3 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
  - 1. Neoprene complying with ASTM C 864.
  - 2. EPDM complying with ASTM C 864.
  - 3. Silicone complying with ASTM C 1115.
  - 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

### 2.4 GLAZING SEALANTS

- A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  3. Colors of Exposed Glazing Sealants: As indicated by manufacturer's designations.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Applications: Glazing in hollow metal doors.

## 2.5 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.6 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- F. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

## 2.7 INSULATING-GLASS TYPES

- A. Glass Type for use in exterior hollow metal doors and windows (storefront): Low-e-coated, tinted insulating glass.
  - 1. Overall Unit Thickness: In accordance with door manufacturer's requirements.
  - 2. Thickness of Each Glass Lite: In accordance with door manufacturer's requirements.
  - 3. Outdoor Lite: Tinted fully tempered float glass.
  - 4. Interspace Content: Argon.
  - 5. Indoor Lite: Clear fully tempered float glass.
  - 6. Low-E Coating: Pyrolytic on second surface.
  - 7. Visible Light Transmittance: In accordance with door manufacturer's requirements.
  - 8. Winter Nighttime U-Factor: In accordance with door manufacturer's requirements.
  - 9. Summer Daytime U-Factor: In accordance with door manufacturer's requirements.
  - 10. Solar Heat Gain Coefficient: In accordance with door manufacturer's requirements.
  - 11. Provide safety glazing labeling.

## PART 3 - EXECUTION

### 3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

### 3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.



- E. Install gaskets so they protrude past face of glazing stops.

### 3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 088000

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## SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes gypsum board shaft wall assemblies.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each component of gypsum board shaft wall assembly.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

#### 2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated.
- B. STC Rating: As indicated.
- C. Gypsum Shaftliner Board: As indicated on UL Assembly.
- D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.
- E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:
  - 1. Depth: As indicated.
  - 2. Minimum Base-Metal Thickness: As indicated.
- F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
  - 1. Minimum Base-Metal Thickness: As indicated.

- G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

## 2.3 AUXILIARY MATERIALS

- A. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- C. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
- D. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).
- E. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged.
- D. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- E. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
  - 1. Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.
  - 2. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

- F. Penetrations: Install supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.
- G. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.
- H. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
- I. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- J. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.
- K. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.
- L. Remove and replace panels that are wet, moisture damaged, or mold damaged.

END OF SECTION 092116.23

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## SECTION 092900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.
3. Texture finishes.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each texture finish indicated on same backing indicated for Work.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

#### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

#### 2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. Thickness: 5/8 inch.
  2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

## 2.4 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
  - 1. Thickness: 5/8 inch.
  - 2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

## 2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
  - 2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
    - g. Curved-Edge Cornerbead: With notched or flexible flanges.

## 2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  - 1. Interior Gypsum Board: Paper.
  - 2. Exterior Gypsum Soffit Board: Paper.
  - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
  - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:



1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

## 2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

## 2.8 TEXTURE FINISHES

- A. Primer: As recommended by textured finish manufacturer.

## PART 3 - EXECUTION

### 3.1 APPLYING AND FINISHING PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C 840.

- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- E. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- H. Cementitious Backer Units: Finish according to manufacturer's written instructions.

### 3.2 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

### 3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

## SECTION 093013 - CERAMIC TILING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Porcelain tile.
  - 2. Tile backing panels.
  - 3. Crack isolation membrane.
  - 4. Metal edge strips.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples:
  - 1. Each type and composition of tile and for each color and finish required.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

### PART 2 - PRODUCTS

#### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

## 2.2 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.
  - 1. Thickness: 5/8 inch.

## 2.3 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
- C. PVC Sheet: PVC heat-fused on both sides to facings of nonwoven polyester; 0.040-inch nominal thickness.
- D. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.
- E. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.
- F. Fabric-Reinforced, Modified-Bituminous Sheet: Self-adhering, modified-bituminous sheet with fabric reinforcement facing; 0.040-inch nominal thickness.
- G. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
- H. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
- I. Latex-Portland Cement Crack-Resistant Mortar: Flexible mortar consisting of cement-based mix and latex additive.
- J. Crack Isolation Membrane and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both a crack isolation membrane and tile-setting adhesive in a two-step process.

## 2.4 SETTING MATERIALS

- A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
- B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
  - 1. For wall applications, provide nonsagging mortar.

## 2.5 GROUT MATERIALS

- A. Standard Cement Grout: ANSI A118.6.

## 2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
- C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. 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 toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

### 3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    - a. Tile floors consisting of tiles 8 by 8 inches or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.
- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Porcelain Tile: minimum recommended by Manufacturer.
- H. Metal Edge Strips: Install at locations indicated and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- I. Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- J. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

### 3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
  - 1. Ceramic Tile Installation: TCNA F115; thinset mortar; epoxy grout.

- a. Thinset Mortar: Standard dry-set mortar.
- b. Grout: Water-cleanable epoxy grout.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

- 1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
  - a. Thinset Mortar: Standard dry-set mortar.
  - b. Grout: Water-cleanable epoxy grout.

END OF SECTION 093013

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## SECTION 095113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Delegated-Design Submittal: For seismic restraints for ceiling systems.
  - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.
- B. Product test reports.
- C. Research reports.
- D. Field quality-control reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- C. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Class C according to ASTM E 1264.
  - 2. Smoke-Developed Index: 450 or less.

## 2.2 ACOUSTICAL PANELS

- A. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E 1264.

## 2.3 METAL SUSPENSION SYSTEM

- A. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M.

## 2.4 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Hold-Down Clips: Manufacturer's standard hold-down.
- C. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.
- D. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical panels in place during a seismic event.

## 2.5 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

# PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.2 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
  - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
  - 3. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.

END OF SECTION 095113

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## SECTION 096513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Vinyl base.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

### PART 2 - PRODUCTS

#### 2.1 VINYL BASE

- A. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).
  - 1. Group: I (solid, homogeneous).
  - 2. Style and Location:
    - a. Style A, Cove: .
- B. Minimum Thickness: 0.125 inch.
- C. Height: 4 inches.
- D. Lengths: Coils in manufacturer's standard length.
- E. Outside Corners: Preformed.
- F. Inside Corners: Job formed.
- G. Colors and Patterns: As indicated on finish schedule..

#### 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

### 3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. Preformed Corners: Install preformed corners before installing straight pieces.
- G. Job-Formed Corners:
  - 1. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
    - a. Miter or cope corners to minimize open joints.

### 3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

END OF SECTION 096513

## SECTION 096519 - RESILIENT TILE FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Static-dissipative vinyl composition floor tile.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and pattern specified.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

#### 2.2 STATIC-DISSIPATIVE VINYL COMPOSITION FLOOR TILE

- A. Tile Standard: ASTM F 1066, Class 2, through pattern.

#### 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
  - 4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### 3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.



1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
1. Lay tiles with grain direction alternating in adjacent tiles (basket-weave pattern).
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
1. Apply one coat(s).

END OF SECTION 096519

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## SECTION 096723 - RESINOUS FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This section includes the following:
  - 1. 3-part resinous flooring system including moisture-mitigating primer.
  - 2. 3-color resinous flooring system as shown on the drawings.
    - a. Color 1: 5' wide aircraft parking restriction area around 3 exterior walls.
    - b. Color 2: aircraft parking area.
    - c. Color 3: 3' x 3' outlined box with 4" stripe and Color 2 inset at wheeled fire extinguishers (WFE) location(s).
    - d. Slip resistance: 6' x 5' area at all egress doors.
  - 3. Colors: To be selected by Architect from Manufacturer's full standard range.
- B. Related Sections:
  - 1. Section 012300 Alternates.

#### 1.2 SYSTEM DESCRIPTION

- A. The work shall consist of preparation of the substrate, the furnishing and application of a pigmented epoxy-based floor coating system with urethane topcoat. The system shall have the color and texture as specified by the Owner with a nominal thickness of 35 mils. It shall be applied to the prepared area(s) as defined in the plans strictly in accordance with the Manufacturer's recommendations.

#### 1.3 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. Colors, texture, and thickness shall be representative of overall appearance of finished system subject to normal tolerances.

#### 1.4 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 specified System.
- D. System shall be in compliance with requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.
- E. 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.
- F. Mockups: Apply mockups of each coating system indicated to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Floor Surfaces: Apply samples on at least 100 sq. ft. of prepared floor surface.
  - 2. Allow to cure, and perform bond strength test to verify adhesion.
  - 3. Final approval of color selections will be based on mockups.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Coatings: 1 gal. of each material and color applied.

#### 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 storage area for all components. The area shall be between 60 F and 90 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 Owner 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 90 F providing the substrate temperature is above the dew point. Outside of this range, the Manufacturer shall be consulted.
2. Do not apply when the relative humidity of the concrete is greater than 99% (at 40% depth of slab).
3. 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.
4. The Applicator shall ensure that adequate ventilation is available for the work area.
5. The Applicator shall be supplied with adequate lighting equal to the final lighting level during the preparation and installation of the system.
6. Note: General Contractor to provide acceptable temperature and relative humidity conditions suitable for resinous flooring placement at no additional cost to the Owner.

B. Conditions of new concrete to be coated with epoxy material.

1. Concrete shall be at least 5 days old, properly prepared, sound and stable prior to the application of the system.
2. Concrete shall be profiled, clean, dry, oil free and sound.
3. Perform in situ probe method testing per ASTM F2170 to determine relative humidity levels

C. Safety Requirements

1. All open flames and spark-producing equipment shall be removed from the work area prior to commencement of application.
2. "No Smoking" signs shall be posted at the entrances to the work area.
3. The Owner shall be responsible for the removal of foodstuffs from the work area.
4. Non-related personnel in the work area shall be kept to a minimum.

## 1.8 WARRANTY

- A. Manufacturer warrants that material shipped to buyers at the time of shipment substantially free from material defects and will perform substantially to manufacturer's published literature if used in accordance with the latest prescribed procedures and prior to the expiration date.
- B. Manufacturer's liability with respect to this warranty is strictly limited to the value of the material purchase.
- C. Special Warranty: Installer agrees to repair or replace components of resinous flooring that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion for Base Coat and Top Coat.
  2. Warranty Period: Ten years from date of Substantial Completion for Primer.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis of Design: Subject to compliance with requirements, provide products manufactured by: Dur-A-Flex, Inc., 95 Goodwin Street, East Hartford, CT 06108, Phone: (860) 528-9838, Fax: (860) 528-2802, or comparable system by one of the following, subject to Owner's evaluation and consideration:
- B. Alternate Manufacturers:
  - 1. Sherwin Williams.
  - 2. Tennant.
  - 3. Dudick.
  - 4. Plexi-Chemie.
  - 5. Econo Surf.
  - 6. Sikaflor.
  - 7. Armor Rez Jet Deck 200 System.
  - 8. Tnemec.
- C. Manufacturer of Approved System shall be single source and made in the USA.

### 2.2 HIGH-PERFORMANCE COATINGS, GENERAL

- A. Material Compatibility:
  - 1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
  - 3. Provide products of same manufacturer for each coat in a coating system.
- B. Colors: Selected by Owner from manufacturer's full color palette.

### 2.3 FLOORING

- A. Dur-A-Flex, Inc, Dur-A-Gard, Epoxy-Based seamless flooring system
  - 1. System Materials:
    - a. Primer: Dur-A-Flex, Inc, Dur-A-Glaze MVP resin and hardener.
    - b. Base Coat: Dur-A-Flex, Inc, Dur-A-Gard resin and hardener.
    - c. Topcoat: Dur-A-Flex, Inc. Armor Top resin, hardener and grit.
  - 2. Patch Materials
    - a. Shallow Fill and Patching: Use Dur-A-Flex, Inc. Dur-A-Glaze Rapid-Patch.
    - b. Deep Fill and Sloping Material (over ¼ inch): Use Dur-A-Flex, Inc. Dur-A-Crete.

## 2.4 PRODUCT REQUIREMENTS

- |     |   |                            |
|-----|---|----------------------------|
| A.  | Primer  | Dur-A-Glaze MVP            |
| 1.  | Percent Solids  | 100 %                      |
| 2.  | VOC   | 0 g/L                      |
| 3.  | Viscosity at 70°F (mixed hardener and resin)  | 1,400 cps                  |
| 4.  | Hardness, ASTM D  | 2240 75-80                 |
| 5.  | Compressive Strength, ASTM D 695  | 11,200 psi                 |
| 6.  | Tensile Strength ASTM D 638   | 2,100 psi                  |
| 7.  | Flexural Strength   | 5,100 psi                  |
| 8.  | Permeability ASTM E96   | <1.0 perms (non-permeable) |
| B.  | Base Coat   | Dur-A-Gard                 |
| 1.  | Percent Solids  | 100 %                      |
| 2.  | VOC   | 3.45 g/L                   |
| 3.  | Compressive Strength, ASTM D 695  | 16,000 psi                 |
| 4.  | Tensile Strength, ASTM D 638  | 3,800 psi                  |
| 5.  | Flexural Strength, ASTM D 790   | 4,000 psi                  |
| 6.  | Abrasion Resistance, ASTM D   | 4060                       |
|     | C-10 Wheel, 1,000 gm load, 1,000 cycles   | 35 mg loss                 |
| 7.  | Flame Spread/NFPA-101, ASTM E 84  | Class A                    |
| 8.  | Flammability, ASTM D 635  | Self Extinguishing         |
| 9.  | Impact Resistance MIL D-3134  | 0.025 inch Max             |
| 10. | Water Absorption. MIL D-3134  | 0.04 %                     |
| 11. | Potlife @ 70 F  | 20-25 minutes              |
| C.  | Topcoat   | Armor Top                  |
| 1.  | Percent Solids  | 95 %                       |
| 2.  | VOC   | 0 g/L                      |
| 3.  | Tensile Strength, ASTM D 2370   | 7,000 psi                  |
| 4.  | Adhesion, ASTM 4541   | Substrate Failure          |
| 5.  | Hardness, ASTM D 3363   | 4H                         |
| 6.  | 600 Gloss ASTM D 523  | 70                         |
| 7.  | Abrasion Resistance, ASTM D4060   | Gloss Satin                |
|     | CS 17 wheel (1,000 g load) 1,000 cycles   | 4 8 mg loss with grit      |
|     |   | 10 12 mg loss without grit |
| 8.  | Pot Life, 70 F, 50% RH  | 2 Hours                    |
| 9.  | Full Chemical Resistance  | 7 days                     |
| D.  | Slip resistance: Where additional slip resistance is required broadcast and backroll 36 grit white aluminum oxide at a rate of 1 pound per 100 square foot into the final urethane topcoat. |                            |
| E.  | Joint Sealant: Manufacturer's recommended joint sealant for application indicated.  |                            |

## 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 relative humidity test using in situ probes per ASTM F 2170. Proceed with installation only after substrates have a maximum 99% relative humidity level measurement.
    - b. If the vapor drive exceeds the allowable relative humidity per the Manufacturer's specifications, the Contractor shall incur the cost of procurement and 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. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
  - 4. 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 3-4 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 1/8 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.
  - 5. 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. Priming
  - c. Base coat application.
  - 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 Owner.
5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.

#### B. Primer

1. The primer shall be Dur-A-Glaze MVP that is mixed at the ratio of 2 parts resin to 1 part hardener per the manufacturer's instructions.
2. The primer shall be applied using a 3/16" notched squeegee and back rolled with a 3/8" nap roller at the rate of 100 sf/gal to yield a dry film thickness of 16 mils.

#### C. Base Coat

1. The base coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer.
2. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
3. The base coat shall be applied over horizontal surfaces using "v" notched squeegee and back rolled at the rate of 100 sf/gal to yield a dry film thickness of 16 mils.

#### D. Topcoat

1. The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
2. The topcoat shall be comprised of a liquid resin, hardener and grit that is mixed per the manufacturer's instructions.
3. The finished floor will have a nominal thickness of 35 mils.

### 3.4 FIELD QUALITY CONTROL

#### A. Tests, Inspection

1. The following tests shall be conducted by the Applicator:
  - a. Temperature
2. 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 096816 - SHEET CARPETING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Woven carpet.

#### 1.2 PREINSTALLATION MEETINGS

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

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For carpet installation, showing the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
  - 2. Carpet type, color, and dye lot.
  - 3. Seam locations, types, and methods.
  - 4. Types, colors, and locations of edge, transition, and other accessory strips.
  - 5. Transition details to other flooring materials.
- C. Samples: For each exposed product and for each color and texture required.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.6 WARRANTY

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 WOVEN CARPET

- A. Product: As indicated on finish schedule.

### 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
- C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Concrete Slabs:
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet manufacturers. Proceed with installation only after substrates pass testing.
- B. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

### 3.2 PREPARATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard" and with carpet manufacturer's written installation instructions for preparing substrates.

- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

### 3.3 CARPET INSTALLATION

- A. Comply with CRI's "CRI Carpet Installation Standard" and carpet manufacturer's written installation instructions for the following:
  - 1. Direct-glue-down installation.
  - 2. Double-glue-down installation.
  - 3. Carpet with attached-cushion installation.
  - 4. Preapplied adhesive installation.
  - 5. Hook-and-loop installation.
  - 6. Stretch-in installation.
  - 7. Stair installation.
- B. Comply with carpet manufacturer's written instructions and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
  - 1. Stretch-in Carpet Installation: Install carpet cushion seams at 90-degree angle with carpet seams.
- C. Install pattern parallel to walls and borders.
- D. Install borders with mitered corner seams.
- E. Do not bridge building expansion joints with carpet.
- F. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- G. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- H. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on subfloor. Use nonpermanent, nonstaining marking device.

- I. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by carpet manufacturer and carpet adhesive manufacturer.

END OF SECTION 096816

## SECTION 097700 - FIBERGLASS REINFORCED PLASTIC (FRP) PANELS

### 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. Section Includes:
  - 1. Plastic sheet paneling.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product data, specifications, and installation instructions.
- B. Shop Drawings: Submit shop drawings indicating location and size of each panel, and other pertinent data.
- C. Submit samples to the Architect for approval.
  - 1. Two sets of samples showing complete, full range of colors for Architect's selection.

#### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.5 WARRANTY

- A. The manufacturer shall warrant each panel installation against manufacturing defects within specified warranty period:
  - 1. Warranty Period: Ten years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PLASTIC SHEET PANELING

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.
  - 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Composites, Inc.
    - b. Glasteel
    - c. Kemlite Company Inc.
    - d. Marlite
    - e. Newcourt, Inc.
    - f. Nudo Products, Inc.
    - g. Parkland Plastics, Inc.
  - 2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 3. Nominal Thickness: Not less than 0.12 inch.
  - 4. Surface Finish: Smooth.
  - 5. Color: As selected by Architect from manufacturer's full range.

### 2.2 ACCESSORIES

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  - 1. Color: As selected by Architect from manufacturer's full range.
- B. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.
- C. Adhesive: As recommended by plastic paneling manufacturer.
- D. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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



- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.
- B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- D. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.
  - 1. Mark plumb lines on substrate at panel joint locations for accurate installation.
  - 2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

### 3.3 INSTALLATION

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive.
- C. Install trim accessories with adhesive.
- D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- F. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.
- G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 097700

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## SECTION 099113 - EXTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on exterior substrates.

#### 1.2 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and each color and gloss of topcoat.
- C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

#### 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

## 1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

### 2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- D. Colors: As indicated on Drawings.
  - 1. 10 percent of surface area will be painted with deep tones.

### 2.3 PRIMERS/SEALERS

- A. Primer, Alkali Resistant, Water Based: MPI #3.

- B. Primer, Bonding, Water Based: MPI #17.
- C. Primer, Bonding, Solvent Based: MPI #69.
- D. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.

## 2.4 METAL PRIMERS

- A. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.
- B. Primer, Alkyd, Quick Dry, for Metal: MPI #76.
- C. Primer, Galvanized, Water Based: MPI #134.
- D. Primer, Galvanized: As recommended in writing by topcoat manufacturer.
- E. Primer, Quick Dry, for Aluminum: MPI #95.

## 2.5 WOOD PRIMERS

- A. Primer, Latex for Exterior Wood: MPI #6.
- B. Primer, Alkyd for Exterior Wood: MPI #5.
- C. Primer, Oil for Exterior Wood: MPI #7.

## 2.6 WATER-BASED PAINTS

- A. Latex, Exterior Flat (Gloss Level 1): MPI #10.
- B. Latex, Exterior Semi-Gloss (Gloss Level 5): MPI #11.
- C. Latex, Exterior, Gloss (Gloss Level 6: MPI #119.
- D. Light Industrial Coating, Exterior, Water Based (Gloss Level 3): MPI #161.
- E. Light Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss Level 5): MPI #163.
- F. Light Industrial Coating, Exterior, Water Based, Gloss (Gloss Level 6): MPI #164.

## 2.7 ACRYLIC ELASTOMERIC MASONRY COATING SYSTEMS

- A. Prime Coat: Clear Masonry Sealer
  - 1. Sherwin-Williams: Loxon clear masonry primer/sealer, LX02W0050.
  - 2. GAF: Masonex clear sealer.
  - 3. Dulux: Perma-Crete clear sealer.

- B. Intermediate Coat: Exterior Acrylic Elastomeric Coating
  - 1. Sherwin-Williams: SherLastic 100% acrylic elastomeric coating; A05W00651. Smooth texture, flat finish.
- C. Topcoat: Exterior Acrylic Elastomeric Coating
  - 1. Sherwin-Williams: SherLastic 100% acrylic elastomeric coating; A05W00651. Smooth texture, flat finish. Architect to select finish color from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMU): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Portland Cement Plaster: 12 percent.
  - 5. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 EXTERIOR PAINTING SCHEDULE

#### A. Concrete Substrates, Traffic Surfaces:

##### 1. Latex Floor Paint System:

- a. Prime Coat: Floor paint, latex, low gloss (maximum Gloss Level 3), MPI #60.
- b. Intermediate Coat: Floor paint, latex, low gloss (maximum Gloss Level 3), MPI #60.
- c. Topcoat: Floor paint, latex, low gloss (maximum Gloss Level 3), MPI #60.

#### B. Steel Substrates:

##### 1. Quick-Drying Enamel System:

- a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
- b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
- c. Topcoat: Alkyd, quick dry, semi-gloss (Gloss Level 5), MPI #81.
- d. Topcoat: Alkyd, quick dry, gloss (Gloss Level 7), MPI #96.

#### C. Galvanized-Metal Substrates:

##### 1. Latex System:

- a. Prime Coat: Primer, galvanized, water based, MPI #134.
- b. Prime Coat: Primer, galvanized metal, as recommended in writing by topcoat manufacturer for exterior use on galvanized-metal substrates with topcoat indicated.
- c. Intermediate Coat: Latex, exterior, matching topcoat.
- d. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.

#### D. Wood and Fiber Cement Substrates: Including trim and siding.

##### 1. Latex System:

- a. Prime Coat: Primer, latex for exterior wood, MPI #6.
- b. Intermediate Coat: Latex, exterior, matching topcoat.

- c. Topcoat: Latex, exterior flat (Gloss Level 1), MPI #10 for siding
- d. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11 for trim.

E. Plastic Trim Fabrication Substrates:

1. Latex System:

- a. Prime Coat: Primer, bonding, water based, MPI #17.
- b. Intermediate Coat: Latex, exterior, matching topcoat.
- c. Topcoat: Latex, exterior semi-gloss (Gloss Level 5), MPI #11.

END OF SECTION 099113



## SECTION 099123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Steel.
  - 2. Gypsum board.
- B. Related Sections:
  - 1. Section 012300 Alternates.

#### 1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.

#### 1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed in the Interior Painting Schedule for the paint category indicated.
- B. Basis-of-Design Manufacturer: Sherwin-Williams.
  - 1. Alternate Manufacturers.
    - a. Benjamin Moore & Co.
    - b. PPG Architectural Finishes, Inc.

#### 2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates.
  - 1. Alkyd System. Anticorrosive.
    - a. Prime Coat: Quick-drying alkyd metal primer.
      - 1) Sherwin-Williams, Industrial & marine, Ken Kromik Universal Alkyd Primer, B50NZ6.

- b. Intermediate Coat: Interior alkyd matching topcoat.
  - 1) Sherwin-Williams, ProMar 200, Alkyd Semi-Gloss, B34W251.
- c. Topcoat: Interior (finish as scheduled.)
  - 1) Sherwin-Williams, ProMar 200, Alkyd Semi-Gloss, B34W251.

B. Gypsum Board Substrates.

1. Latex System.

- a. Prime Coat: Interior latex primer/sealer.
  - 1) Sherwin-Williams, ProMar 200 Interior Latex Primer B28W08200.
- b. Intermediate Coat: Interior latex matching topcoat.
  - 1) Flat (Gloss Level 1).
    - a) Sherwin-Williams, ProMar 200 Zero VOC Interior Flat, B30W2600 Series.
  - 2) Egg-Shell (Gloss Level 3).
    - a) Sherwin-Williams, ProMar200 Zero VOC Interior Latex Egg-Shell, B20W4026 Series.
  - 3) Semi-Gloss (Gloss Level 5).
    - a) Sherwin-Williams, ProMar 200 Zero VOC Interior Latex Semi-Gloss, B34W2600 Series.
- c. Topcoat: Interior latex (finish as scheduled).
  - 1) Flat (Gloss Level 1).
    - a) Sherwin-Williams, ProMar 200 Zero VOC Interior Flat, B30W2600 Series.
  - 2) Egg-Shell (Gloss Level 3).
    - a) Sherwin-Williams, ProMar200 Zero VOC Interior Latex Egg-Shell, B20W4026 Series.
  - 3) Semi-Gloss (Gloss Level 5).
    - a) Sherwin-Williams, ProMar 200 Zero VOC Interior Latex Semi-Gloss, B34W2600 Series.

END OF SECTION 099123

## SECTION 101423 - SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Panel signs.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples: For each exposed product and for each color and texture specified.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

#### 1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
- B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

### 2.2 SIGNS

- A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Solid-Sheet Sign: Aluminum sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph below and as follows:
    - a. Surface-Applied Graphics: Applied vinyl film.
  - 2. Sign-Panel Perimeter: Finish edges smooth.
  - 3. Mounting: Surface mounted to wall with countersunk flathead through fasteners.
  - 4. Surface Finish and Applied Graphics:
    - a. Painted Finish and Graphics: Manufacturer's standard, factory-applied exterior-grade sign paint, in color as selected by Architect from manufacturer's full range.
  - 5. Size:
    - a. Provide size indicated on drawings and/or as scheduled in Part 3 below.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

### 3.2 SIGN SCHEDULE

- A. No-Smoking Signs: Provide 10" high x 14" wide min. signs with min. 2" high letters indicating "NO SMOKING" at interior and exterior side of all exterior hollow metal doors for each building as indicated on the Architectural drawings. Letter color to contrast with sign color.
- B. Building Address: Provide 2 building number address signs identical to existing signs in use on other hangars at the Airport for each building.
- C. Fire Extinguisher Signs: Provide 10" high x 18" wide min. signs with min. 2" high letters indicating "THIS AREA TO REMAIN CLEAR" at all portable and wheeled fire extinguisher locations for each building. Letter color to contrast with sign color.
- D. Aircraft Clear Area Signs: Provide 10" high x 18" wide min. signs with min. 2" high letters indicating "KEEP PERIMETER AREA CLEAR OF AIRCRAFT ENGINES AND FUEL TANK AREAS". Letter color to coordinate with sign color. Confirm locations, colors and text with Architect.
  - 1. Quantities:
    - a. 6 for the Box Hangar.
    - b. 36 for the T- Hangars.
- E. Hazardous Operation Signs: Provide 10" high x 18" wide min. signs with min. 2" high letters indicating "NO HAZARDOUS OPERATIONS, INCLUDING FUEL TRANSFER, WELDING, TORCH CUTTING, TORCH SOLDERING, DOPING, AND SPRAY PAINTING ARE TO OCCUR IN THE HANGAR." Letter color to contrast with sign color. Confirm locations, colors and text with Architect.
  - 1. Quantities:
    - a. 6 for the Box Hangar.
    - b. 36 for the T- Hangars.
- F. Fuel Capacity Signs: Provide 10" high x 18" wide min. signs with min. 2" high letters indicating "TOTAL FUEL CAPACITY OF ALL AIRCRAFT WITHIN HANGAR IN THIS BUILDING LIMITED TO 1,600 GALLONS." Letter color to contrast with sign color. Confirm locations, colors and text with Architect. Provide 1 per hangar bay in both the Box Hangar and the T-Hangars.
- G. Wing Height Signs: Provide 10" high x 18" wide min. signs with min. 2" high letters indicating "MAXIMUM AIRCRAFT WING HEIGHT 18'-0"." Letter color to contrast with sign color. Confirm locations, colors and text with Architect. Provide 1 per hangar bay in the Box Hangar. Mounting height at Box Hangars signs to be 10'-0".

END OF SECTION 101423

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## SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 Insert requirement.

## 2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  - 1. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
    - a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.
    - b. Color(s): As selected by Architect from manufacturer's full range.
  - 2. Sign-Panel Perimeter: Finish edges smooth.
  - 3. Mounting: Manufacturer's standard method for substrates indicated with.
  - 4. Quantity: Provide 1 sign for each room in each building.

## 2.3 SIGN MATERIALS

- A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.

## 2.4 ACCESSORIES

- A. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

## 2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  - 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
  - 2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
  - 3. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
  - 1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

END OF SECTION 101423.16

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## SECTION 102600 - WALL AND DOOR PROTECTION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Corner guards.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
- C. Shop Drawings: For each type of wall and door protection showing locations and extent.
  - 1. Include plans, elevations, sections, and attachment details.
- D. Samples: For each exposed product and for each color and texture specified, 12 inches long.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Material certificates.
- C. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.

### 2.2 CORNER GUARDS

- A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
  - 1. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness; in dimensions and profiles indicated on Drawings.
    - a. Color and Texture: As selected by Architect from manufacturer's full range.
  - 2. Continuous Retainer: One-piece extruded plastic.
  - 3. Retainer Clips: Manufacturer's standard impact-absorbing clips.
  - 4. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

### 2.3 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D256, Test Method A.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- D. Adhesive: As recommended by protection product manufacturer.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
  - 1. Provide anchoring devices and suitable locations to withstand imposed loads.
  - 2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
  - 3. Adjust end and top caps as required to ensure tight seams.

END OF SECTION 102600

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## SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Underlavatory guards.
3. Custodial accessories.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: Full size, for each exposed product and for each finish specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.5 WARRANTY

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
1. Warranty Period: 15 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of two keys to Owner's representative.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

END OF SECTION 102800

## SECTION 104413 - FIRE PROTECTION CABINETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes fire-protection cabinets for portable fire extinguishers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

#### 1.4 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

#### 1.5 SEQUENCING

- A. Apply decals on field-painted fire-protection cabinets after painting is complete.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.

#### 2.2 FIRE-PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
- B. Cabinet Construction: Match fire rating of surrounding partition.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Cabinet Material: Cold-rolled steel sheet.
- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
  1. Square-Edge Trim: 1-1/4- to 1-1/2-inch backbend depth.
  2. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Cabinet Trim Material: Same material and finish as door.
- F. Door Material: Steel sheet.
- G. Door Style: Fully glazed, frameless, backless, acrylic panel.
- H. Door Glazing: Tempered float glass (clear).
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- J. Accessories:
  1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
    - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
      - 1) Location: Applied to cabinet door.
      - 2) Application Process: Decals.
      - 3) Lettering Color: Red.
      - 4) Orientation: Vertical.
- K. Materials:
  1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
    - a. Finish: Baked enamel or powder coat.
    - b. Color: As selected by Architect from full range of industry colors and color densities.
  2. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

## 2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
- D. Identification: Apply decals at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

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## SECTION 104416 - FIRE EXTINGUISHERS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes:
  - 1. Portable fire extinguishers for Office.
  - 2. Wheeled fire extinguishers for Hangar.
  - 3. KNOX-BOX for Hangar.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Six years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

## 2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet indicated.
  - 1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Regular Dry-Chemical Type: UL-rated ABC nominal capacity, with sodium bicarbonate-based dry chemical in manufacturer's standard enameled container.

## 2.3 WHEELED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each and mounting bracket indicated. Quantities and locations shown on Architectural drawings.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Amerex Halotron I Model # 673 Capacity 4A:50B:C type or approved equal.
- C. Color: Red.

## 2.4 KNOX BOX

- A. KNOX-BOX: Provide product in accordance with local authority having jurisdiction (AHJ). Provide surface mounted product in and aluminum finish. Tamper switch option not required. Coordinate keying and mounting location with AHJ.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
  - 1. Mounting Brackets: 48" above finished floor to access area of fire extinguisher.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- D. KNOX-BOX: Install in accordance with manufacturer's written instructions at location specified by AHJ.

END OF SECTION 104416



## SECTION 107313 - AWNINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Building-supported, pre-engineered fixed metal awnings including fascia channels, decking, tension rods, and attachment hardware.

#### 1.2 DEFINITIONS

- A. Awning: An architectural projection that provides weather protection, identity, or decoration and is wholly supported by the building to which it is attached. An awning is comprised of a lightweight, rigid skeleton structure over which a rigid covering is attached.

#### 1.3 REFERENCES

- A. Aluminum Association (AA)DAF 45 – Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association (AAMA).
  - 1. 2603 – Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Architectural Extrusions and Panels.
- C. American Society of Civil Engineers (ASCE) 7 – Minimum Design Loads for Buildings and Other Structures.
- D. ASTM International (ASTM).
  - 1. B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
  - 2. B429 – Standard Specification for Aluminum-Alloy Extruded Pipe and Tube.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General: Design, fabricate, and install awnings to withstand loads from gravity, wind and snow; and to resist, without failure, other conditions of in-service use, including exposure to weather.

#### 1.5 SUBMITTALS

- A. Product Data: Include styles, material descriptions, construction details, fabrication details, dimensions of individual components and profiles, hardware, fittings, mounting accessories, features, finishes, and operating instructions for awnings.

- B. Shop Drawings: Show location and extent of awnings. Include elevations, sections, and details not shown in Product Data. Show materials, fabrication, dimensions, mounting heights, connections, anchorages, installation details, attachments to other work, operational clearances, and relationship to adjoining work.
  - 1. Show locations for blocking, reinforcement, and supplementary structural support to be provided by others.
- C. Samples for Verification: Provide sample of metal panel and full range of available colors

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum (5) years experience in similar work.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- C. Source Limitations: Obtain awnings through one source from a single manufacturer.

## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Where awning installation is indicated to fit to other work, verify dimensions of other work by field measurements before fabrication and indicate measurements on Shop Drawings. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## 1.8 WARRANTY

- A. Warranty: Manufacturer's standard form in which manufacturer and fabricator agree to repair or replace components of awnings that fail in materials or workmanship within specified warranty period.
  - 1. Exposed Roof Panel Finish Warranty Period: Twenty (20) years.
  - 2. Awning Frame Warranty Period: Five (5) years.
  - 3. Awning Installation Warranty Period: One (1) year.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Basis-of-Design Manufacturer: "Extrudeck Series" by MASA Architectural Canopies, 21 Randolph Avenue, Avenel, NJ 07001, (800) 761-7446.
  - 1. Alternate Manufacturers:
    - a. Victory Awning, 6801 Old Randol Mill Road, Fort Worth, TX 76120 (817) 759-1600.
    - b. Perfection Architectural Systems, Inc., 2310 Mercator Drive, Orlando, FL 32807, (800) 238-7207.
    - c. Or approved equal.

## 2.2 MATERIALS

- A. Aluminum Extrusions:
  - 1. ASTM B221& ASTM B429 6063-T5 alloy and temper.
- B. Hardware:
  - 1. All fasteners shall be (stainless steel) or (zinc coated) for corrosion resistance.

## 2.3 COMPONENTS

- A. Framing:
  - 1. Type: Extruded aluminum “J” channel fascia
  - 2. Size: 8” x .125”
- B. Canopy Supports: Extruded Aluminum Canopy Support “I” Beam
- C. Decking: 3” x 6” x .090” Interlocking Extruded aluminum flat soffit decking (as selected from MASA decking options)
- D. Attachment: 1.050” diameter steel hanger rod, finished to match canopy.
- E. Custom Fascia Profiles: 8” Industrial.
- F. Other Components: other components as indicated or as required for system attachment and performance.

## 2.4 ACCESSORIES

- A. Obscurity Screen Top Enclosure System with .090 aluminum flanged frame, Ferrari cover Soltis 86 (selected by architect from manufacturers’ color choices).
- B. Lighting: Surface Mount Type as indicated on electrical drawings.
- C. Down spouts 2” x 3”, .125 Heavy Extruded, Finished to match building color.

## 2.5 FABRICATION

- A. Fabricate canopy system in accordance with approved Shop Drawings.
- B. Kit canopies to be mechanically assembled with shear stress strength as per engineering. Pre-assembled canopies are shop welded by manufacturer’s approved personnel.
- C. Drainage system to be concealed type. Covered surfaces direct water to field drilled drain, to be coordinated at site.

## 2.6 FINISHES

- A. Aluminum:

1. Pre- Treatment: Pre-treat to ASTM D1730 type B, Method 5 using a multi stage chromate process or an approved chrome- free pretreatment process approved by powder coating manufacturer for optimized weather resistance.
2. Finish coat: AAMA 2603 Thermosetting Polyester Resin-based Powder
3. Source: Tiger Drylac powder coating or equivalent.
4. Color: to be selected by architect from manufacturer's full color range

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for supporting members, blocking, inserts, installation tolerances, lighting, and other conditions affecting performance.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. General: Install awnings at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.
- B. Install awnings after other finishing operations, including joint sealing and painting, have been completed.
- C. Attach metal roof panels to frames as recommended by fabricator.
- D. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing awnings to structural support and for properly transferring load to in-place construction.

#### 3.3 CLEANING AND PROTECTION

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Clean awning surfaces after installation, according to manufacturer's written instructions.
- C. Touchup Painting: Immediately after erection, clean field welds, connections, and abraded areas. Paint uncoated and abraded areas with same or compatible material as used for shop-applied finish painting.
- D. Galvanized Surfaces: Clean field welds, connections, and abraded areas and repair galvanizing.
- E. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that awnings are without damage or deterioration at time of Substantial Completion.

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LBT T-Hangar and 2-Unit Box Hangar  
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END OF SECTION 107313

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## SECTION 113100 - APPLIANCES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Cooking appliances.
  - 2. Refrigeration appliances.
  - 3. Ice-making appliances.
  - 4. Television displays and mounting brackets.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Sample warranties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

#### 1.6 WARRANTY

- A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.2 ICE MAKERS

- A. Locations: As indicated on the Drawings.
- B. Quantity: 2. Include in the Base Bid amount.
- C. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:
  - 1. Scotsman C0530SA-1D 525 lb. Prodigy Small Cube Ice Maker with Stainless Steel Exterior Bin – 536 lb. Storage, Air Cooled, 115V. Quantity: 1. <https://www.webstaurantstore.com/scotsman-c0530sa-1d-prodigy-series-30-air-cooled-small-cube-ice-machine-with-stainless-steel-exterior-bin-525-lb/720KC53S53BS.html>
- D. Alternate Manufacturers:
  - 1. Kold-Draft.
  - 2. Manitowoc.

## 2.3 REFRIGERATOR/FREEZERS

- A. Locations: As indicated on the Drawings.
- B. Quantity: 2. Include in the Base Bid amount.
- C. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:
  - 1. Turbo Air M3RF45-2-N 50” Solid Dual Temperature, 15 CF Freezer / 20.93 CF Refrigerator. Quantity: 1. <https://www.webstaurantstore.com/turbo-air-m3rf45-2-n-50-m3-series-solid-door-dual-temperature-reach-in-freezer-refrigerator/902M3RF452N.html>
- D. Alternate Manufacturers:
  - 1. True Refrigeration.
  - 2. Beverage-Air.

## 2.4 REFRIGERATOR/FREEZERS

- A. Locations: As indicated on the Drawings.
- B. Quantity: 2. Do not include in the Base Bid amount. Include 1 each in the bid amount of Alternate No. 1 and Alternate No. 2.
- C. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:
  - 1. Samsung 28 CF 4-Door French Door Fingerprint Resistant Refrigerator with FlexZone Drawer (stainless steel finish). Model No.: RF28R7201SF/AA. Quantity: 1. <https://www.bestbuy.com/site/samsung-28-cu-ft-4-door-french-door-fingerprint-resistant-refrigerator-with-flexzone-drawer-stainless-steel/6323216.p?skuId=6323216>
- D. Alternate Manufacturers:
  - 1. GE.
  - 2. LG.



## 2.5 DISHWASHERS

- A. Locations: As indicated on the Drawings.
- B. Quantity: 2. Do not include in the Base Bid amount. Include 1 each in the bid amount of Alternate No. 1 and Alternate No. 2.
- C. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:
  - 1. Samsung 24" Top Control Built-In Dishwasher (stainless steel finish). Model No.: DW80R2031US. Quantity: 1. <https://www.bestbuy.com/site/samsung-24-top-control-built-in-dishwasher-stainless-steel/6336699.p?skuId=6336699>
- D. Alternate Manufacturers:
  - 1. KitchenAid.
  - 2. LG.

## 2.6 MICROWAVE OVENS – K-7

- A. Locations: As indicated on the Drawings.
- B. Quantity: 2. Do not include in the Base Bid amount. Include 1 each in the bid amount of Alternate No. 1 and Alternate No. 2.
- C. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:
  - 1. Samsung 1.1 Cu. Ft. Countertop Microwave, 1000W, Model No. MG11H2020CT (stainless steel finish). Quantity: 1. <https://www.bestbuy.com/site/samsung-1-1-cu-ft-countertop-microwave-with-grilling-element-stainless-steel/8578027.p?skuId=8578027>
- D. Alternate Manufacturers:
  - 1. GE.
  - 2. Sharp.

## 2.7 TELEVISION DISPLAYS – K-8

- A. Locations: As indicated on the Drawings.
- B. Quantity: 8. Do not include in the Base Bid amount. Include 4 each in the bid amount of Alternate No. 1 and Alternate No. 2.
- C. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide the following:
  - 1. LG 60" Class LED, 2160p, Smart, 4K UHD TV with HDR, Model No. 60UM6900PUA (black finish). Provide 1 adjustable mounting bracket per unit. <https://www.bestbuy.com/site/lg-60-class-led-um6900pua-series-2160p-smart-4k-uhd-tv-with-hdr/6362419.p?skuId=6362419>
- D. Alternate Manufacturers:
  - 1. Samsung.
  - 2. Vizio.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- B. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.

END OF SECTION 113100

## SECTION 122413 - ROLLER WINDOW SHADES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Product test reports.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

## 2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
  - 1. Chain-Retainer Type: Clip, jamb mount.
  - 2. Spring Lift-Assist Mechanisms: Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.
- B. Crank-and-Gear Operating Mechanisms: Sealed gearbox drive system controlled by detachable crank handle.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
  - 1. Roller Drive-End Location: Right side of interior face of shade.
  - 2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
  - 1. Shadeband Material: Light-filtering fabric.
  - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material.
    - b. Color and Finish: As selected by Architect from manufacturer's full range.
- G. Installation Accessories:
  - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
  - 2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
  - 3. Endcap Covers: To cover exposed endcaps.
  - 4. Recessed Shade Pocket: Rectangular, extruded-aluminum enclosure designed for recessed ceiling installation; with front, top, and back formed as one piece, end plates, and removable bottom closure panel.
  - 5. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.
  - 6. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.

7. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
8. Installation Accessories Color and Finish: As selected from manufacturer's full range.

## 2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Light-Filtering Fabric: Architect to select pattern and material opacity from manufacturer's full range; stain and fade resistant.
  1. Source: Roller shade manufacturer.
  2. Type: Fiberglass textile with PVC film bonded to both sides.
  3. Orientation on Shadeband: Up the bolt.
  4. Features: Washable.
  5. Color: As selected by Architect from manufacturer's full range.

## 2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
  1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
  2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
  1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
  2. Skylight Shades: Provide battens and seams at uniform spacings along shadeband as required to ensure shadeband tracking and alignment through its full range of movement without distortion or sag of material.
  3. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

## PART 3 - EXECUTION

### 3.1 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
  - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- C. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

## SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.
4. Quartz agglomerate apron fronts.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

### PART 2 - PRODUCTS

#### 2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
1. Colors and Patterns: As indicated on Finish Schedule.
- B. Particleboard: ANSI A208.1, Grade M-2.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

#### 2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WT's "Architectural Woodwork Standards."
1. Grade: Premium.
- B. Configuration:
1. Front: Straight, slightly eased at top.

2. Backsplash: Straight, slightly eased at corner.
  3. End Splash: Matching backsplash.
- C. Countertops: 3/4-inch- thick, quartz agglomerate.
- D. Backsplashes: 1/2-inch- thick, quartz agglomerate.
- E. Joints: Fabricate countertops in sections for joining in field.
- F. Cutouts and Holes:
1. Undercounter Plumbing Fixtures: Make cutouts for fixtures using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

## 2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.
- D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- F. Install aprons to backing and countertops with adhesive.
- G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."



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LBT T-Hangar and 2-Unit Box Hangar  
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END OF SECTION 123661.19

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## SECTION 133419 - METAL BUILDING SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Structural-steel framing.
  - 2. Metal roof panels.
  - 3. Insulated metal roof panels.
  - 4. Metal wall panels.
  - 5. Insulated metal wall panels.
  - 6. Thermal insulation.
  - 7. Accessories.
  - 8. Gutters and downspouts.
  - 9. Snow guards.
- B. Related Sections:
  - 1. Section 012200 Unit Prices.

#### 1.2 DEFINITIONS

- A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in referenced standards.
- B. Other Terms: The metal building system described in this Section may be referenced elsewhere in the drawings and specifications using the following terms, including, but not limited to, "pre-engineered metal building", "PEMB", "metal building", "metal building manufacturer", "building manufacturer", and "metal building system".

#### 1.3 SUBMITTALS

- A. Product Data: For each type of metal building system component. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
  - 1. Structural-steel-framing system.
  - 2. Metal roof panels.
  - 3. Insulated metal roof panels.
  - 4. Metal wall panels.
  - 5. Insulated metal wall panels.
  - 6. Metal liner panels.
  - 7. Translucent panels.
  - 8. Insulation and vapor retarder facings.
  - 9. Flashing and trim.
  - 10. Accessories.

11. Gutters and downspouts.
  12. Snow guards.
- B. Shop Drawings: For the following metal building system components. Include plans, elevations, sections, details, and attachments to other work.
1. Anchor-Bolt Plans: Submit anchor-bolt plans and templates before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
  2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
    - a. Show sprinkler mains.
  3. Metal Roof (and Wall Panel) Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory and field-assembled work; show locations of exposed fasteners.
    - a. Show roof-mounted items including penetrations.
    - b. Show wall-mounted items including doors, louvers, and lighting fixtures.
  4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:
    - a. Flashing and trim.
    - b. Gutters.
    - c. Downspouts.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of sizes indicated below:
1. Metal Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
- D. Delegated-Design Submittal: For metal building systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Welding certificates.
- F. Metal Building System Certificates: For each type of metal building system, from manufacturer.
1. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:
    - a. Name and location of Project.
    - b. Order number.
    - c. Name of manufacturer.
    - d. Name of Contractor.
    - e. Building dimensions including width, length, height, and roof slope.
    - f. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
    - g. Governing building code and year of edition.
    - h. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
    - i. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.

- j. Building-Use Category: Indicate category of building use and its effect on load importance factors.
  - k. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC-Certified Manufacturer.
- G. Erector Certificates: For each product, from manufacturer.
- H. Manufacturer Certificates: For each product, from manufacturer.
- 1. Include data indicating structural steel primer compatibility with finish system specified in Division 09 Painting or High Performance Coatings Sections, as applicable.
- I. Material Test Reports: For each of the following products:
- 1. Structural steel including chemical and physical properties.
  - 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
  - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
  - 4. Non-shrink grout.
- J. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for insulation and vapor-retarder facings. Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.
- K. Field quality-control reports.
- L. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.
- M. Maintenance Data: For metal panel finishes to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer.
- 1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
  - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Land Surveyor Qualifications: A professional land surveyor who practices in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.
- C. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.
- D. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- E. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

- F. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- G. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.
- H. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
- B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

#### 1.6 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.
- B. Field Measurements:
  - 1. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.

#### 1.7 COORDINATION

- A. Coordinate sizes and locations of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leak proof, secure, and non-corrosive installation.

## 1.8 WARRANTY

- A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory applied finishes within specified warranty period.
  - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a N8 rating when tested according to ASTM D 4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
  - 1. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide Basis of Design product or product from one of the acceptable alternate manufacturers.
  - 1. Basis of Design: Nucor Building Systems, Swansea, SC.
- B. Alternate Manufacturers: Subject to compliance with requirements, the following alternate manufacturers are acceptable, subject to the conditions outlined below.
  - 1. Nucor Building Systems, Swansea, SC.
  - 2. Ceko Building Systems, Columbus, MS.
  - 3. Universal Steel of America, Suwanee, GA.
  - 4. Olympia Steel Building Systems, McKees Rocks, PA.
  - 5. General Steel Corporation, Littleton, CO.
  - 6. Varco Pruden Buildings, Memphis, TN.
  - 7. Inland Building Systems, Cullman, AL.
  - 8. A&S Buildings, Caryville, TN.
  - 9. Kirby Building Systems, Portland, TN.
  - 10. American Buildings Company, Eufaula, AL.
  - 11. ACI Building Systems, Batesville, MS.
  - 12. Vulcan Steel Structures, Adel, GA.
  - 13. Star Building Systems, Oklahoma City, OK.
  - 14. Butler Manufacturing, Kansas City, MO.
  - 15. Oakland Metal Buildings, Inc., Florence, AL.
- C. Foundation Changes: Design load reactions can range between different building manufacturers and different hangar doors. Contractor to adjust cost of foundation changes, whether increase or decrease, will be adjusted using the unit price as indicated in Section 012200 Unit Prices.

## 2.2 METAL BUILDING SYSTEMS

- A. Description: Provide a complete, integrated set of metal building system manufacturer's standard mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.
  - 1. Provide metal building system of size and with bay spacings, roof slopes, and spans indicated.
- B. Primary-Frame Type:
  - 1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.
- C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable, consisting of primary frame, capable of supporting one-half of a bay design load, and end-wall columns.
- D. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.
- E. Secondary-Frame Type: At Hangar Door Wall: Manufacturer's standard purlins and joists and flush-framed girts.
- F. Eave Height: As indicated on Drawings.
- G. Bay Spacing: As indicated on Drawings.
- H. Roof Slope: As indicated on Drawings
- I. Roof System: As indicated on Drawings.
- J. Exterior Wall System: As indicated on Drawings.

## 2.3 METAL BUILDING SYSTEM PERFORMANCE

- A. Delegated Design: Design metal building system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."
  - 1. Design Loads: As required by all applicable codes, including, but not limited to the 2018 North Carolina Building Code.
    - a. Metal building system shall be designed for snow loads associated with an unheated structure.
    - b. Metal building system shall be designed for wind pressures associated with an enclosed and partially enclosed structure as required for the conditions when the personnel and hangar doors are open and when they are closed.
  - 2. Deflection Limits: Design metal building system assemblies to withstand design loads with deflections no greater than the following:



- a. Purlins and Rafters: Vertical deflection of 1/180 of the span.
  - b. Girts: Horizontal deflection of 1/180 of the span.
  - c. Metal Roof Panels: Vertical deflection of 1/180 of the span.
  - d. Metal Wall Panels: Horizontal deflection of 1/180 of the span.
  - e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.
  - f. Contractor to coordinate acceptable deflection along hangar door opening column line with hangar door manufacturer and within acceptable tolerances of the NC building code.
3. Metal panel assemblies shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ASTM E 1592.
- C. Seismic Performance: Metal building systems shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- D. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change (Range): 120 deg F , ambient; 180 deg F, material surfaces.
- E. Air Infiltration for Metal Roof Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of roof area when tested according to ASTM E 1680 at negative test-pressure difference of 1.57 lbf/sq. ft.
- F. Air Infiltration for Metal Wall Panels: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at static-air-pressure difference of 1.57 lbf/sq. ft.
- G. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E 1646 at test-pressure difference of 2.86 lbf/sq. ft.
- H. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E 331 at a wind-load design pressure of not less than 2.86 lbf/sq. ft.
- I. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.
- J. Energy Performance: Provide roof panels with Solar Reflectance Index not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

## 2.4 STRUCTURAL-STEEL FRAMING

- A. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
    - a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
  2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
  3. Frame Configuration: Single gable.
  4. Exterior Column Type: Tapered.
  5. Rafter Type: Tapered.
  6. Provide framed openings for future hollow metal doors, overhead coiling doors, and windows as indicated on Drawings.
- B. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet.
- C. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch- wide flanges.
    - a. Depth: As needed to comply with system performance requirements.
  2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch- wide flanges.
    - a. Depth: As required to comply with system performance requirements.
  3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.
  4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch diameter, cold-formed structural tubing to stiffen primary-frame flanges.
  5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
  6. Base or Sill Angles: Minimum 3-by-2-inch zinc-coated (galvanized) steel sheet.
  7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from structural-steel sheet.
  9. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
  10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- D. Bracing: Provide adjustable wind bracing as follows:
1. Rods: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 ; or ASTM A 529/A 529M, Grade 50 ; minimum 1/2-inch- diameter steel; threaded full length or threaded a minimum of 6 inches at each end.

2. Cable: ASTM A 475, 1/4-inch- diameter, extra-high-strength grade, Class B, zinc-coated, seven-strand steel; with threaded end anchors.
  3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
  4. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural steel shapes to match primary framing; of size required to withstand design loads.
  5. Fixed-Base Columns: Fabricated from shop-welded, built-up steel plates or structural steel shapes to match primary framing; of size required to withstand design loads.
  6. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
- E. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide hot-dip galvanized bolts for structural-framing components.
- F. Materials:
1. W-Shapes: ASTM A 992/A 992M; ASTM A 572/A 572M, Grade 50 or 55 ; or ASTM A 529/A 529M, Grade 50 or 55 .
  2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 ; or ASTM A 529/A 529M, Grade 50 or 55 .
  3. Plate and Bar: ASTM A 36/A 36M; ASTM A 572/A 572M, Grade 50 or 55 ; or ASTM A 529/A 529M, Grade 50 or 55 .
  4. Structural-Steel Sheet: Hot-rolled, ASTM A 1011/A 1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 ; or cold-rolled, ASTM A 1008/A 1008M, Structural Steel (SS), Grades 25 through 80 , or High-Strength Low-Alloy Steel (HSLAS), Grades 45 through 70 .
  5. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low-Alloy Steel (HSLAS), Grades 50 through 80 ; with G60 coating designation; mill phosphatized.
  6. Non-High-Strength Bolts, Nuts, and Washers: ASTM A 307, Grade A , carbon-steel, hexhead bolts; ASTM A 563 carbon-steel hex nuts; and ASTM F 844 plain (flat) steel washers.
    - a. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  7. High-Strength Bolts, Nuts, and Washers: ASTM A 325 , Type 1, heavy-hex steel structural bolts; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
    - a. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  8. High-Strength Bolts, Nuts, and Washers: ASTM A 490 , Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with spline ends; ASTM A 563 heavy-hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers, plain.
    - a. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  9. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with spline ends.
    - a. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  10. Unheaded Anchor Rods: ASTM A 572/A 572M, Grade 50.
    - a. Configuration: Straight.
    - b. Nuts: ASTM A 563 heavy-hex carbon steel.
    - c. Plate Washers: ASTM A 36/A 36M carbon steel.
    - d. Washers: ASTM F 436 hardened carbon steel.
    - e. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
  11. Headed Anchor Rods: ASTM A 307, Grade A .
    - a. Configuration: Straight.

- b. Nuts: ASTM A 563 heavy-hex carbon steel.
  - c. Plate Washers: ASTM A 36/A 36M carbon steel.
  - d. Washers: ASTM F 436 hardened carbon steel.
  - e. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- 12. Threaded Rods: ASTM A 572/A 572M, Grade 50.
  - a. Nuts: ASTM A 563 heavy-hex carbon steel.
  - b. Washers: ASTM A 36/A 36M carbon steel.
  - c. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.
- G. Finish: Factory primed. Apply specified primer immediately after cleaning and pre-treating.
  - 1. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.
    - a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.
  - 2. Prime galvanized members with specified primer after phosphoric acid pretreatment.
  - 3. Primer: Acceptable to manufacturer of finish paint system specified in Division 09 painting section.

## 2.5 METAL ROOF PANELS

- A. Vertical-Rib, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
  - 1. Material: Aluminum-zinc alloy-coated steel sheet, 0.028-inch/24-gage nominal thickness.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.
  - 2. Clips: Manufacturer's standard, floating type to accommodate thermal movement; fabricated from stainless-steel sheet.
  - 3. Joint Type: Mechanically seamed, double folded.
  - 4. Panel Coverage: 24 inches.
  - 5. Panel Height: 2 inches or 3 inches with a trapezoidal leg.
  - 6. Uplift Rating: UL 90.

## 2.6 METAL WALL PANELS

- A. Tapered-Rib-Profile, Exterior Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.
  - 1. Material: Aluminum-zinc alloy-coated steel sheet, 0.022-inch/26-gage nominal thickness.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.
  - 2. Major-Rib Spacing: 12 inches o.c.
  - 3. Panel Coverage: 36 inches.
  - 4. Panel Height: 1.125 inches.
- B. Tapered-Rib-Profile, Interior Metal Liner Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be

installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Aluminum-zinc alloy-coated steel sheet, 0.022-inch/26-gage nominal thickness.
2. Exposed Finish: Siliconized polyester.
3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
  - a. Color: As selected by Architect from manufacturer's full range.
4. Major-Rib Spacing: 12 inches o.c.
5. Panel Coverage: 36 inches.
6. Panel Height: 1.25 inches.

## 2.7 THERMAL INSULATION

- A. Mineral-Fiber-Blanket Insulation: ASTM C 665, type indicated below; consisting of fibers manufactured from glass, slag wool, or rock wool. Insulation R-values are shown on the drawings.
  1. Non-reflective Faced: Type II (blankets with non-reflective membrane covering), Category 1 (membrane is a vapor retarder), Class A (membrane-faced surface with a flame-spread index of 25 or less).
- B. Retainer Strips: 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.
- C. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder. Color to match facing material color.
- D. Thermal Blocking: Provide thermal blocking with pressure-treated lumber at roof framing purlins per manufacturer's standard details and installation practices.

## 2.8 DRAFT CURTAIN

- A. Longitudinal draft curtain, perpendicular to building main frames, as shown on Architectural drawings.
  1. Arrangement: Bottom shall run parallel with the roofline.
  2. Framing: Standard draft curtain framing field assembled with angles and self-drilling fasteners provided by manufacturer. Angles field cut to length. Provide all structural components required for complete system.
  3. Materials: Manufacturer's standard draft curtain sheeting and flashing consisting of 28-gauge white wall panels with color matching trim at walls, roof and base panel. Color to be confirmed with Architect.
  4. Height: As indicated on Drawings. Provide manufacturer's standard draft curtain framing.
  5. Painting: All exposed structural components to be painted to match exposed Metal Building System structural steel.

## 2.9 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
  - 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated. Confirm color with Architect.
  - 1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
  - 2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.
  - 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet or nylon-coated aluminum sheet.
  - 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 5. Closure Strips: Closed-cell, expanded, cellular, rubber or cross-linked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  - 6. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated. Confirm color with Architect.
  - 1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 3. Closure Strips: Closed-cell, expanded, cellular, rubber or cross-linked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
  - 4. Thermal Spacer Blocks: Where metal panels attach directly to purlins, provide thermal spacer blocks of thickness required to provide 1-inch standoff; fabricated from extruded polystyrene.
- D. Flashing and Trim: Formed from 0.022-inch/26-gage nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match adjacent metal wall or roof panels. Confirm colors with Architect.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.
  2. Opening Trim: Formed from 0.034-inch nominal-thickness, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters: Formed from 0.022-inch/26-gage nominal-thickness, metallic-coated steel sheet or aluminum zinc alloy-coated steel sheet pre-painted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch- long sections, sized according to SMACNA's "Architectural Sheet Metal Manual." Size as indicated on drawings.
1. Gutter Supports: Fabricated from same material and finish as gutters.
  2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.
  3. Color to be selected by Architect from manufacturer's full palette range.
- F. Downspouts: Formed from 0.022-inch/26-gage nominal-thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot- long sections, complete with formed elbows and offsets. Size as indicated on drawings.
1. Mounting Straps: Fabricated from same material and finish as gutters.
  2. Color to match metal panel siding. Confirm color with Architect.
  3. Downspouts to daylight onto Contractor provided concrete splash blocks.
- G. Snow Guards:
1. Provide complete snow guard system. Provide Basis-of-Design Product: ColorGard manufactured by S-5 or approved equal. Components to match roof color.
    - a. Alternate Manufacturer: SnowMax Standing Seam as manufactured by Alpine SnowGuards.
  2. Ice Stopper: Provide "ice stopper" centered on panel and mounted perpendicular to roof panel to prevent sliding over exterior door entrances.
- H. Pipe Flashing: Pre-molded, EPDM pipe collar with flexible aluminum ring bonded to base.
- I. Materials:
1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
    - a. Fasteners for Metal Roof Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel head.
    - b. Fasteners for Metal Wall Panels: Self-drilling, Type 410 stainless-steel or self-tapping, Type 304 stainless-steel or zinc-alloy-steel hex washer head.
    - c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
    - d. Blind Fasteners: High-strength stainless-steel rivets.
  2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, non-corrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.
4. Metal Panel Sealants:
  - a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape of manufacturer's standard size.
  - b. Joint Sealant: ASTM C 920; one-part elastomeric silicone; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

## 2.10 FABRICATION

- A. General: Design components and field connections required for erection to permit easy assembly.
  1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
  2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.
- B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.
- C. Primary Framing: Shop fabricate framing components to indicated size and section, with Base plates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
  1. Make shop connections by welding or by using high-strength bolts.
  2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
  3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
  4. Weld clips to frames for attaching secondary framing.
  5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP Shop prime primary framing with specified primer after fabrication.
- D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with base plates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
  1. Make shop connections by welding or by using non-high-strength bolts.
  2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP Shop prime uncoated secondary framing with specified primer after fabrication.
- E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.
  - 1. Engage land surveyor to perform surveying.
- C. Proceed with erection only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

### 3.3 ERECTION OF STRUCTURAL FRAMING

- A. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- D. Base and Bearing 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. 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.
  - 3. Promptly pack 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 shrinkage-resistant grouts.
- E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.
- F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level base plates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level baseline elevation. Moist-cure grout for not less than seven days after placement.
1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.
    - a. Joint Type: Snug tightened or pre-tensioned.
- G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
  2. Locate and space wall girts to suit openings such as doors and windows.
  3. Locate canopy framing as indicated.
  4. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- H. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
1. Tighten rod and cable bracing to avoid sag.
  2. Locate interior end-bay bracing only where indicated.
- I. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- J. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

### 3.4 METAL PANEL INSTALLATION, GENERAL

- A. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.
1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.
- B. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
    - a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
  2. Install metal panels perpendicular to structural supports unless otherwise indicated.
  3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  4. Locate and space fastenings in uniform vertical and horizontal alignment.

5. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.
  6. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.
1. Seal metal panel end laps with double beads of tape or sealant the full width of panel side joints where recommended by metal panel manufacturer.
  2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

### 3.5 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
1. Install ridge caps as metal roof panel work proceeds.
  2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.
- B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.
1. Install clips to supports with self-drilling or self-tapping fasteners.
  2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
  3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
  4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Pre-drill panels for fasteners.
  5. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge caps.
- C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.
- D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.6 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Coordinate installation with Section 07 "Weather Barriers."
  - 2. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
  - 3. Shim or otherwise plumb substrates receiving metal wall panels.
  - 4. When two rows of metal panels are required, lap panels 4 inches minimum.
  - 5. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
  - 6. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Pre-drill panels.
  - 7. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
  - 8. Install screw fasteners in predrilled holes.
  - 9. Install flashing and trim as metal wall panel work proceeds.
  - 10. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.
  - 11. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
  - 12. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.
- C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet , non-accumulative, on level, plumb, and on location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.7 THERMAL INSULATION INSTALLATION

- A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
  - 1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
  - 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
  - 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
  - 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
  - 1. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.

- a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
  - 1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- D. Mockup: Provide mockup of finished installation of wall insulation in a typical wall bay and in a section of the roof for Architect's and Owner's approval. Notify Architect and Owner within 24 hours of completion of mockup.

### 3.8 ACCESSORY INSTALLATION

- A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  - 3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
- B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).
- C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.in between.
  - 1. Provide elbows at base of downspouts to direct water away from building.

2. Tie downspouts to underground drainage system indicated.
- E. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

### 3.9 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Inspection of fabricators.
  2. Steel construction.
- B. Tests and Inspections:
1. High-Strength, Field-Bolted Connections: Connections shall be tested and inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
  2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.
- C. Product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.10 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or re-prime field connections, rust spots, and abraded surfaces of prime-painted structural framing and accessories.
1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
  2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- D. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 133419

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## SECTION 220000 – PLUMBING

### 220001 GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.
- B. Contractor shall provide coordination drawings per Division 1.
- C. Plumbing work shall be performed as outlined in “Information for Bidders”.
- D. These specifications and the accompanying plumbing drawings are intended to provide for all labor, materials and equipment necessary for the installation complete of all
  - 1. Plumbing Fixtures
  - 2. Equipment
  - 3. Rough-Ins
  - 4. Waste And Vent System
  - 5. Oil Separator
  - 6. Condensate Drainage System
  - 7. Cold Water System
  - 8. Hot Water System
  - 9. Fuel Gas System

and accessories including necessary apparatus, valves and fittings hereinafter described or called for on the plumbing drawings accompanying these specifications.

- E. All plumbing work shall be installed in accordance with the following Codes and all Local Ordinances. Materials, equipment and workmanship shall be as hereinafter specified.
  - 1. North Carolina State Plumbing Code
  - 2. National Electrical Code
  - 3. North Carolina State Fuel Gas Code
  - 4. ICC A117.1
  - 5. NSF Standard # 61
- F. This contractor shall secure all required permits and inspection fees necessary for this work. Permits may be secured from the Building Inspections Department.
- G. The accompanying drawings are schematic only and are not intended to show all fittings, bolts, connections, offsets, etc., unless specifically dimensioned. Follow drawings as closely as possible, provide all adjustments as necessary to conform to the structural conditions, machinery, equipment, work of other contractors and the intent of the drawings, without additional cost to the Owner. Plumbing drawings should not be scaled. Secure dimensions from Architectural drawings. Refer to drawings of other trades and coordinate with other contractors. All items of equipment shall be installed in accordance with the manufacturer’s published installation instructions and diagrams.
- H. The Contractor shall coordinate water and sewer taps and pay all fees in conjunction to provide services as required, for this project.

### 220002 SCOPE OF WORK

- A. The Contractor shall be required to perform all the following work, in general and provide a complete plumbing system as shown on the plans. The items in general are to be as follows:

1. Furnish and install complete waste and vent system with connections to services as shown on the plumbing drawings and here-in specified.
2. Furnish and install cold water system complete with connections to point as shown on the plumbing drawings and here-in specified.
3. Furnish and install hot water system complete with connections to equipment as shown on the plumbing drawings and here-in specified.
4. Furnish and install fuel gas piping system with connections to equipment as noted and/or as shown on the plumbing drawings and here-in specified.
5. Furnish and install condensate drainage system as shown on the plumbing drawings and here-in specified.
6. Provide plumbing fixtures and connections to plumbing systems as shown on the plumbing drawings and here-in specified.
7. Provide connections to equipment furnished and installed by General Contractor or Owner as shown on the plumbing drawings and here-in specified.

220003 LIST OF MATERIALS, FIXTURES AND EQUIPMENT

- A. The Plumbing Contractor shall obtain written approval from the Engineer/Architect for the use of substitute materials claimed as equal to those specified. Such approvals must be obtained as soon after contract awards as possible and before any materials are ordered. Applications for approvals shall be made by the Plumbing Contractor and not by subcontractors or manufacturer's representative. The Plumbing Contractor shall submit within ten days following award of contract and written notice to begin the work a complete list of materials proposed for the job. All like items shall be by the same manufacturer. When this list is approved, no further substitutions will be permitted except in unusual or extenuating circumstances. If no list is submitted, the Contractor shall supply materials specified. *Contractor should note that all items specified in section 220000 shall be submitted independently of other 220000 series sections.* The Plumbing Contractor shall review and stamp the submittals as being in accordance with his bid and these specifications. **Private labeled materials are not acceptable.**
- B. The Plumbing Contractor shall submit shop drawings to the Architect after award of the contract, and before any materials, fixtures, and equipment to be incorporated in the work has been ordered. Shop drawings shall include the name and address of the manufacturer and their catalog numbers and trade names clearly marked. All items shall be referenced to the plans and specifications by **fixture designation or specification paragraph number on an index tab**. One complete set of submittal data shall be manufacturer's original published material. **FAXED COPIES WILL NOT BE ACCEPTABLE.** Approval of materials will be based upon the manufacturer's published ratings. Submit shop drawings and/or catalog data for the following material and equipment:
  1. Waste Piping, Fittings and Couplings
  2. Condensate Piping, Fittings and Couplings
  3. Water Piping, Fittings and Equipment
  4. Fuel Gas Piping, Fittings and Equipment
  5. Circulator Pumps
  6. Oil Interceptor
  7. Cleanouts and Access Doors
  8. Valves
  9. Insulation
  10. Hangers
  11. U. L. penetration systems
  12. Pipe Markers
  13. Fixtures
  14. Coordination Drawings per Division 1.
- C. Approval of shop drawings and/or submittal data shall not relieve the Plumbing Contractor of the responsibility to comply with the requirements and intent of the plans and specifications with regard to

dimensions, capacities, quality, quantity, performance characteristics, etc. If data submitted deviates from the contract documents, the Plumbing Contractor shall point out such deviations in writing and also state reasons for same. All similar items shall insofar as possible be one make and manufacturer.

- D. Where any special make, fixture or materials are specified by plate number, trademark or name, deliver to the building with original labels or other identification marks placed thereon by the manufacturer and do not remove until inspected and approved by the Architect. Similar and equal materials and equipment by other manufacturers will be acceptable, subject to approval.
- E. Failure to submit materials, equipment, fixtures, etc., in the time period specified above, the Architect shall assume that all items shall be installed as specified.

#### 220004 WORKMANSHIP

##### A. Layout:

- 1. Drawings indicate general locations of fixtures. Secure exact location from Architectural plans before proceeding with work.
- 2. Furnish and install all necessary sleeves, inserts, bolts, etc., for concrete floor slabs, roof, walls, and partitions. Failure to install such items in time to avoid delaying the general contractor shall result in the Contractor doing all cutting and repairing at his own expense.
- 3. Sleeves as here-in-after specified shall be installed on all through the floor piping above slab on grade except water closet rough-ins. Water closet rough-ins shall be cast in place. Core drilling of slabs shall be sealed with approved fire retardant caulking and sealed watertight.
- 4. All equipment shall be installed in accordance with manufacturer's written installation instructions.

##### B. Drainage, Waste and Vent Piping:

- 1. Grade all sanitary waste lines 2" and smaller 1/4" per foot.
- 2. Grade all sanitary waste lines 3" and larger 1/4" per foot, where possible, 1/8" per foot minimum.
- 3. Grade all condensate drain lines 1/8" per foot.
- 4. All underground piping shall be graded by the use of a laser beam alignment system.
- 5. All floor drains shall be set 1/2 inch below the room finished floor perimeter and the entire floor sloped to the floor drain.
- 6. Run all piping as directly as possible, avoiding unnecessary bends and turns so as not to interfere with proper installation of work of other contractors.
- 7. All PVC-DWV piping shall be protected by a cast iron sleeve under the following condition with a sleeve as follows:
  - a. Piping passing thru foundation walls: Sleeve shall extend 6 inches beyond wall footing on both sides.
  - b. Piping passing below a footing: Per Contract Drawings.
- 8. Provide removable caps for cleanouts with at least six threads engaged. Provide cleanouts at foot of waste and drainage stacks, all changes in direction of horizontal lines more than 135 degrees, in straight lines at intervals not exceeding 100-feet and anywhere additionally noted on the drawings.
- 9. Run all horizontal and vertical piping true and plumb to building structure and connect all piping with 'Y' branches and 1/8 or 1/16 bends.
- 10. Tapped tees and crosses will not be permitted. Tapped sanitary tees and crosses shall be used.
- 11. No soil, waste, or vent piping shall be covered or concealed, until tested and approved by the Architect.
- 12. Conceal all soil and vent piping. Vents shall be tied together as shown with minimum number of vents extending through roof. All vents extended through the roof shall be a minimum of 12" above roof level.
- 13. All PVC-DWV and PVC drainage lines shall be bedded per the manufacturer's recommendations and shall be maintained under a continuous head of 10-feet until after all concrete slabs are poured

and/or all heavy equipment has been removed from the site. Contractor shall be responsible for the protection of the piping system at all times including freezing weather.

C. Water System:

1. Conceal water supply piping in walls, below floor or above ceiling except where exposed for connections to fixtures. Install and secure all piping as walls are built. Wedging of piping will not be permitted. All piping shall be isolated from mortar.
2. All water piping shall be routed with a minimum clearance of ten (10) feet from any electrical switchboards, panel boards, telephone backboards, electrical panels, or any other energized components.
3. Arrange all pipes to freely drain through a ball valve when water is cut off. All branch valves shall be installed adjacent to the water piping main.
4. All supplies to fixtures shall have individual stop valves.
5. Provide water hammer shock arrestors as required to prevent water hammer. Arresters shall be A.S.S.E. Standards Number 1010 certified. Arresters shall be installed in accordance with manufacturer's published recommendations. Air chambers are not acceptable. Water hammer shock arrestors shall be as manufactured by Precision Plumbing Products, Inc. or approved equal by Zurn, Josam, J.R. Smith, or Sioux Chief.
6. All exposed piping to fixtures shall be chrome plated installed true and plumb.
7. Insulate all water piping inside the building as hereinafter specified.
8. All tees shall be installed such that the flow shall be straight thru the tee and/or out the side. Tees **shall not** be installed where the flow is into the side and out of both ends of the tee (bullhead tee). Bullhead tees installations are not acceptable and shall not be used.
9. Extend water lines to water mains where shown on the plans.
10. Terminate cold water line 5-feet outside building. Connection at this point will be by the General Contractor.

D. Fuel Gas System:

1. Gas piping shall be concealed in walls or above ceilings unless noted otherwise.
2. Gas piping shall be graded 1/4" per 15-feet towards drip legs. Drip legs shall be full size of the main with removable cap and shall be 6 inches in length.
3. Gas piping shall be installed in accordance with North Carolina State Fuel Gas Code.

E. Insulation:

1. All pipe insulation joints shall be sealed to maintain integrity of the vapor jacket and shall pass thru all sleeves unbroken except for fire stops.
2. Pipe insulation at all fire separations shall be butted tightly to the firewall or to the floor after fire stop material has been installed.

220005 CUTTING, PATCHING AND CHASING

- A. All cutting and patching shall be in accordance with the "General Conditions" of these specifications.

220006 EXCAVATION, TRENCHING AND BACKFILLING

- A. All excavation, trenching and backfilling shall be in accordance with Division 31 of these specifications.

220007 WASTE & VENT SYSTEMS

A. Piping:

1. Waste and vent piping shall be Schedule 40 PVC-DWV solid wall piping conforming to ASTM D-2665-68 and C.S. 272-65 with NSF seal.

B. Fittings:

1. Fittings for PVC-DWV piping shall be PVC-DWV fittings conforming to piping specifications.

C. Joints:

1. Joints for PVC-DWV piping shall be made using the piping manufacturer's approved solvent cement.
2. All threaded piping shall be made up using pipe joint compound or Teflon Tape applied to the male thread of the pipe.
3. Flashing of plumbing vents will be provided by the General Contractor.

D. Oil Separator:

1. Oil Separator shall be high density polypropylene constructed, furnished for below grade installation, three way access, with compartment baffles, field adjustable riser system, minimum capacity of 750 gallons, suitable for H2O loading, high water anti-float kit, oil level monitoring system, with lifetime guarantee. Provide relieving slab per the manufacturer's installation instructions. Oil Separator shall be Striem OT-750 or approved equal by Zurn or MiFab.

220008 CONDENSATE DRAINAGE

A. Piping:

1. Condensate piping shall be Schedule 40 PVC-DWV solid wall, conforming to ASTM D-2665 and C.S. 272.

B. Fittings:

1. Fittings for PVC-DWV piping shall be PVC-DWV fittings conforming to piping specifications.

C. Joints:

1. Joints for PVC-DWV piping shall be made using manufacturer's approved solvent cement.

220009 HOT AND COLD WATER SYSTEMS

A. Water Piping:

1. Water piping 2-1/2" and smaller, below grade, shall be type 'K' soft copper conforming to ASTM B-88.
2. Water piping 3" and larger, below grade, shall be type 'K' hard copper conforming to ASTM B-88.

B. Fittings:

1. Fittings for copper piping shall be wrought copper, solder joint fittings conforming to ANSI B 16.22.
2. Fittings for copper piping 2" and smaller may be press fittings conforming to ASME B16.51 and performance criteria of IAPMO PS 117.

C. Joints:

1. Copper piping solder joints shall be made in accordance with ASTM B828 using solder with a minimum melting point of 410 degrees Fahrenheit. Solder shall conform to ASTM B32. Flux shall conform to ASTM B813. Both solder and flux shall have a composition containing less than 0.2% lead.
2. Press fitting joints shall be made using the press fitting manufacturer's tools and per manufacturer's instructions. Upon completion of the project, the press fitting manufacturer's tools used for installation shall be turned over to the Owner.

D. Backflow Preventer:

1. Backflow preventer shall be lead-free double check valve design, non-health hazard, with strainer, test valves, gate valve on inlet and discharge, inlet and outlet pressure gauges, designed to meet AWWA C-510, ASSE 1015. Unit shall be size as shown on the drawings and be manufactured by Watts LF007S or approved equal by Wilkins, Febco, or Conbraco.

E. Expansion Tank:

1. Expansion tank shall be diaphragm design constructed of welded steel and shall bear the ASME and National Board Stamp for 150 pounds working pressure and 200° F. operating temperature. Fittings shall include test cocks, hose bibb drain and air control fitting. Tank and fittings shall be as manufactured by Amtrol, Bell and Gossett, Thrush or Taco.

F. Thermometers and Gauges:

1. Thermometers shall be metallic element type with 3" dial, Type 304 stainless steel case, accuracy range of 1%, black markings on white face, and designed for variable angle mounting. Thermometers range shall be such that the operating temperature shall be in the middle range for the dial. Thermometers shall be installed in a thermometer well and shall be Weiss Model 3VBM Series or approved equal by Omega or Tel-Tru Mfg. Co.
2. Pressure gauges shall be non-filled with 4" face, 1/4" NPT lower connection with operating range in middle portion of the dial, accuracy range of 1%, and black markings on white face. Pressure gauges shall be installed with lever handle gauge cocks. Pressure gauges shall be Weiss Model 4PG-1 or approved equal by Omega or Tel-Tru Mfg. Co.

220010 FUEL GAS SYSTEM

A. Gas Piping:

1. Gas piping above grade and inside the building shall be standard weight schedule 40 black steel conforming to ASTM A-53.

B. Fittings:

1. Fittings for piping 2" and smaller above grade and inside building shall be malleable iron threaded fittings conforming to ASME B16.3 with threads conforming to ASME B1.20.1.

C. Joints:

1. Joints for threaded piping shall be made using pipe dope applied sparingly to the male thread of pipe. Pipe dope shall be resistant to actions of gas.

D. Pressure Regulators:

1. Regulators shall have the minimum capacities as shown on the drawings with single stage pressure reduction. Regulators shall be equipped with internal over pressure protection. Regulators installed inside the building shall be of the limited venting design.
2. Regulators shall be listed as complying with ANSI Z21.80, and shall be equal to those as manufactured by Maxitrol, American Meter Company, or Invensys.

E. Gas Valves:

1. Gas valves shall be U.L. or AGA approved bronze construction, full port ball with threaded ends designed for 600-PSI gas working pressure conforming to ASME B16.44. Valves located on 2 psi gas lines shall be labeled "2G".
2. Gas valves controlling each piece of equipment shall be full ported, bronze body, threaded ends, ball valve with gauge tapping.

3. Each valve shall be lubricated and turned during the installation to assure good working order. Plug valves shall be greased again after turning to aid the shut off.

F. Connections:

1. The Plumbing Contractor shall coordinate the rough-in connection for the mechanical equipment gas train with the Mechanical Contractor. The Plumbing Contractor shall make the final connection to the gas train with an approved AGA flexible connector.

220011 HOT WATER CIRCULATOR

- A. Circulator shall have capacity as shown on drawings and shall be specifically designed for domestic hot water service.
- B. Circulator shall have lead-free bronze body and flanges with lead-free impeller; circulator motor shall be rubber mounted and shall be equipped with overload protection. Circulator shall be direct connected to motor. Circulator shall be Taco, B&G, or Grundfos with capacity as noted on the drawings.
- C. Circulator shall be supported by appropriate hangers to avoid piping strain. Circulators shall be mounted horizontally.

220012 CLEANOUTS AND ACCESS DOORS

- A. Cleanouts shall be the same diameter as the pipe they are connected to. If the pipe is greater than 4" in diameter, the cleanout shall be 4".
- B. Cleanouts installed in walls or pipe chases shall be installed using PVC-DWV cleanout tee with bronze plug, stainless steel cover with countersunk stainless steel vandalproof securing screw. Cleanouts shall be Zurn ZS-1468, Josam 58600-PLG, or J. R. Smith 4472.
- C. Cleanouts installed in floors and walks shall have adjustable cast iron body with cast brass plug, lead seal and round nickel bronze top with watertight gasketed cover. Cleanouts shall be Zurn ZN-1400, or approved equal by Josam or J. R. Smith.
- D. Cleanouts installed in Hangar Bay floors, or indicated elsewhere on the Contract Drawings as "HDFCO", shall have adjustable cast iron body with cast brass plug, lead seal and heavy-duty veneer nickel bronze top with watertight gasketed cover. Cleanouts shall be installed flush with finished floor. Cleanouts shall be Zurn ZN-1400-HD, or approved equal by Josam or J. R. Smith.
- E. Cleanouts installed outside the building and flush with grade shall be installed flush with 24" x 24" x 6" thick concrete pad. Cleanouts plugs shall be PVC with recessed head. Cleanouts shall be Zurn Z-1474, or approved equal by Josam, J. R. Smith.
- F. Provide owner with tool(s) to allow for cleanout caps to be removed.
- G. Access doors shall be provided for all valves and shock arrestors located behind hard ceilings and in walls to provide access. Ceiling access doors shall be a minimum of 24" x 24" with concealed hinge.

220013 VALVES

- A. Valves shall be installed at all points noted on the plans by standard symbols or as required by best general practice for proper control and operation of the system. All valves shall be identified with 1" diameter, 19 gauge, polished brass identification tags with a number and valve service indicated. Provide a valve chart listing all valves with size and service framed and mounted under glass in the main mechanical room.

Provide a self-sticking 1/2" diameter dot on lay-in ceiling grid at all valve locations. Red dot for domestic hot water supply and return, blue for cold water.

- B. Check valves 2 inch and small shall be Class 125, lead free design cast bronze body with threaded ends.
- C. Domestic cold and hot water system valves 1-1/4 inch and smaller shall be lead free design cast bronze body, full ported, soldered end ball valves rated for Class 150, 200 WOG service.
- D. Domestic cold and hot water system valves 1-1/2 inch and 2 inch shall be lead free design cast bronze body, full ported, threaded end ball valves rated for Class 150, 200 WOG service. Valves shall be provided with stem extensions for insulation thickness specified.

#### 220014 PIPE INSULATION

- A. All plumbing pipe insulation systems shall be installed as a subcontract to the Plumbing contract. All plumbing pipe insulation systems, including jacketing, coverings, adhesives when used, shall have a flame spread rating not exceeding twenty-five (25) and a smoke development rating not exceeding fifty (50) when the insulation assembly is tested as a composite. Fibrous glass pipe insulation shall be pre-molded with a thermal conductivity of 0.24BTU/in/hr/ft<sup>2</sup> at 100°F.
  - 1. Insulate all cold water piping above grade with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant vapor barrier jacket.
  - 2. Insulate all hot water piping, 1-1/2" and smaller, above grade with 1" thick pre-molded fibrous glass pipe insulation with self-sealing fire retardant jacket.
  - 3. Insulate all copper water piping below grade or slab on grade with 1/2" thick pre-molded closed cellular plastic foam pipe insulation.
  - 4. Insulate all hot water return piping with 1" thick fibrous pre-molded glass pipe insulation with self-sealing fire retardant jacket.
- B. Exposed pre-molded pipe insulation in finished areas and mechanical rooms shall be finished with factory jacket neatly pasted in place and left ready for painting as specified hereinafter.
- C. All pipe insulation for pipe fittings shall be pre-molded to fit fittings and shall be enclosed under pre-molded PVC fitting jacket.
- D. All insulated piping exposed to the weather shall be protected with color coded 30 mil PVC jacket cemented in place with PVC fitting covers. Color coding shall be in accordance with ANSI standards.
- E. Plumbing piping located in CMU walls shall be insulated with closed cellular foam insulation with thicknesses as specified above. Foam insulation thermal properties shall match or exceed the specified thermal insulation properties for the intended usage. Insulation shall be secured with insulation manufacturer's approved tape. All copper piping penetrating CMU walls, shall have continuous insulation through penetration. Copper piping shall not come into direct contact with CMU or mortar.
- F. Contractor **may request** that closed cellular foam insulation be used on insulated piping when the building structure is not "dried in" to protect fibrous glass insulation from getting wet. Foam insulation thermal properties shall match or exceed the specified thermal insulation properties for the intended usage. Insulation shall be secured with 16 gauge copper wire at 16 inch centers.

#### 220015 HANGERS

- A. Hangers for vertical piping shall be the Riser Clamp design and shall conform to MSS SP-58, Types 1 through 58.



- B. Hangers for horizontal piping shall be the Clevis type and shall conform to MSS SP-58, Types 1 through 58.
- C. **Hangers for insulated piping shall extend around the insulation.** Provide 16 gage galvanized steel insulation protection saddles 12" long at each hanger on all insulated lines. Insulation Shields shall cover lower 180 degrees of pipe in the case of clevis hangers, and entire circumference of pipe in the case of trapeze hangers or clamps.
- D. Hangers shall be spaced per the NC State Plumbing Code in accordance with the piping material.
- E. A hanger shall be provided within one (1) foot of each bend in horizontal piping. Vertical piping shall be supported at each floor or at intervals not exceeding ten (10) feet.
- F. For piping 4" in diameter and larger, rigid support sway bracing shall be provided at changes in direction greater than 45 degrees.
- G. Hangers shall be fastened by means of threaded rods to steel beam clamps, center of bar joist, center of trusses, etc. All hangers shall permit adequate adjustment after erection while still supporting the load. All hanger rods attached to bar joist and trusses shall be install between bottom or top cords of the structural member. Structural members to span from building structure to structure shall be provided by the Contractor.
- H. Hangers SHALL NOT be fastened to joist bridging or roof deck.
- I. Hangers shall only be hung with drilling into the slab with "drop-in" hangers with the approval of the Structural Engineer of record with complete dead and operating load information provided for each location. Loading information shall be provided by the Plumbing Contractor.
- J. Piping supported on a trapeze hanger shall be secured to the trapeze hanger by means of a pipe clamp around the pipe insulation and insulation saddle. Piping not receiving insulation shall be secured by a pipe clamp and isolated by an isolation cushion.
- K. Piping supported from the floor shall be supported using a base plate securely anchored to the floor and be equipped with riser and pipe clamp. Pipe clamp shall extend around insulation. Riser shall be a minimum of one inch. Horizontal piping above the floor shall be anchored securely in clamp and rest on a manufactured pipe saddle that extends around the full circumference insulation. Locations where piping is to be supported from the floor shall be approved by EOR and architect before drilling into floor.

220016 PIPE SLEEVES, PLATES, ESCUTCHEONS, ETC.

- A. Pipe sleeves shall be standard weight schedule 40 black steel above slab on grade or cast iron below slab on grade. All sleeves shall be equal to construction thickness except that pipe sleeves passing through floors, other than slab on grade, shall extend 3/4" above the finished floor. Pipe sleeve sizes shall be sized two pipe sizes larger than piping passing thru the sleeve.
- B. Piping thru non-fire rated walls, floors above slab on grade or ceilings, piping passing through foundation walls, and piping installed below structural footings shall have sleeves installed concentric and centered on pipe. Ream all sleeves to prevent cutting of piping. The Contractor shall furnish shop drawings to the general contractor and the Architect showing location, dimensions, and sizes of holes required. Sleeves on piping passing through foundation walls shall extend 6" beyond wall footing on both sides. Sleeves on piping installed below structural footings shall extend beyond footing as indicated on contract drawings.
- C. Install escutcheons snug against room finish on all exposed pipe passing through walls, floors above slab on grade or ceilings. Use cup type escutcheons at floors where sleeves extend above finished floors. Escutcheons shall be chrome plated steel with spring clip.

- D. Sleeves for insulated piping shall be large enough to allow the insulation to pass thru sleeve unbroken.
- E. Core drill openings for all floor openings may be utilized in lieu of sleeved openings. All openings shall be sized two pipe sizes larger than pipe passing thru the opening. All cored openings shall be fireproofed as required and shall be made water tight.
- F. All penetrations in rated floors, firewalls and any other rated separations shall be protected using a through-penetration firestopping method with an "F" rating equivalent to the rating of the membrane being penetrated for particular piping materials used and membrane construction type. Floor penetrations shall additionally have a "T" rating equivalent to the rating of the floor being penetrated. Through-penetration firestop systems shall be installed and tested in accordance with ASTM E814 or UL 1479 with a minimum positive pressure differential 0.01 inch w.g. All openings through horizontal fire separations shall be protected by Metacaulk U.L. Systems or approved U.L. listed system by other manufacturers.
- G. All openings through floors and vertical fire separations shall be protected by combination water seal and fire stops as manufactured by HoldRite, or approved equal by Proset, Metacaulk, or 3M.

#### 220017 PLUMBING SYSTEM IDENTIFICATION

- A. All piping in the building shall be identified by snap-on pipe markers or secured with two zip ties. Markers shall have ANSI colored letters at ANSI height on ANSI colored background with flow arrows and shall be located at 10' on center along pipeline, at each tee branch and at each floor/wall penetration, both sides. A pipe marker shall be located adjacent to each valve. Pipe identification markers shall comply with ANSI A13.1 and be Custom MS-790 as manufactured by Marketing Service Incorporated or approved equal Steton, Emed or DuraLabel. Stenciling of piping and/or insulation is not acceptable. Wording on markers shall be as follows where more stringent than ANSI Standards:
  - 1. Cold Water
  - 2. Hot Water
  - 3. Hot Water Return
  - 4. Fuel Gas (with pressure noted)
- B. Engraved plastic laminate signs for listed plumbing equipment shall be 1/16 inch thick and be secured with self-tapping stainless steel screws. Plastic laminate face color shall be red for all emergency applications and black for all other uses. Letter color shall be white. Signage for all equipment, etc., shall show equipment or service identification, capacity, final date of acceptance for equipment item and warranty information. Signage shall be provided for the following items:
  - 1. Water Heaters
  - 2. Oil Level Monitoring Control panel
  - 3. Circulator pumps

#### 220018 PROTECTION OF WORK AND EQUIPMENT

- A. It is imperative that waste and vent lines not be filled with concrete, concrete grindings, sand, gravel, or other foreign matter. Under no circumstances shall any line be left open while the Contractor's workers are not on the job site.
- B. Plug each opening of waste and vent lines the same day it is installed with test plug securely held in place.
- C. All floor drains and hub drains shall be covered immediately after installation.
- D. The Contractor shall be responsible for all work damaged by him/her. Any plumbing work damaged by any other contractor shall be replaced by the Contractor and placed in perfect working condition without

extra cost to the Owner. All fixtures and fittings shall be adequately protected before, during and after installation.

- E. The Contractor shall be responsible for all plumbing fixtures at time of final inspection. Any broken fixtures will be replaced by the Contractor at no cost to the owner regardless of by whom the fixture was broken.

#### 220019 TESTING

- A. The Contractor shall notify the Engineer forty-eight (48) hours in advance of all tests. The Contractor shall make all necessary preliminary tests to insure a tight system. Any joint found to leak under test shall be broken, cleaned and remade.
- B. All tests shall be applied before any work is concealed or covered in any manner.
- C. All sanitary waste, vent and condensate piping shall be tested in the following manner: Plug all openings and fill entire waste and vent system to overflow with water and sustain a constant level for a minimum period of three (3) hours. All portions of each floor system shall be tested under a minimum of a 10-foot head including roof vent terminal.
- D. All waste oil piping shall be tested under a minimum of 50-lbs. per square inch of air pressure and maintained for a minimum of two (2) hours with no loss of pressure.
- E. All water piping, hot and cold shall be made tight under a hydrostatic test pressure of 150-lbs. per square inch and maintained without pressure loss for a minimum of four (4) hours. No caulking of joints will be permitted. Any joint found to leak under this test shall be broken, remade and a new test applied.
- F. All backflow preventers shall be tested and certified by an approved and licensed backflow prevention company.
- G. All fuel gas piping shall be tested by applying an air pressure of 100-lbs. per square inch and shall be maintained for minimum of eight (8) hours. Air receivers shall be charged with peppermint for odor test and any indication of leakage will be checked by applying a soap and water solution at each joint to determine leaking joint. Test shall be conducted using an eight inch pressure-temperature recorder with a pressure range of 0-150-psi with a 24 hour recording time. Pressure measuring elements shall be heat treated to prevent hysteresis-related inaccuracies.
- H. The Contractor shall furnish all necessary equipment, materials and labor to perform the above-specified tests.

#### 220020 STERILIZATION

- A. All new water piping shall be charged with a chlorine solution containing not less than 50-ppm available chlorine. The solution shall remain in the piping for a minimum period of 6 hours, during which time valves shall be opened and closed to permit a small flow of the solution. At the end of the six (6) hours, the solution shall be tested and must contain a residual of at least 5 to 10 ppm chlorine. The system shall then be drained and flushed to provide satisfactory potable water before final connection is made to the existing distribution system.
- B. The Contractor shall contract with an independent Testing Laboratory for a certification letter that the system sterilization meets or exceeds standards for potable water.

220021 PLACING IN SERVICE

- A. Upon completion of the entire system installation, the entire system and all equipment shall be tested by actual operation to provide that it will function as intended.
- B. The Contractor shall flush all waste piping prior to final connection to existing system, to ensure that no foreign materials are in these lines, and that a continuous flow of water and waste can be affected.
- C. The Contractor shall flush all water piping prior to the connection of flush valves, mixing valves, and faucet aerators to provide a clean and operational water system.
- D. The Contractor shall place the entire system in a satisfactory operating condition and shall furnish all assistance and instructions required by the Owner's representative during initial operating period. The Contractor shall acquaint the Owner's representative with the special parts required for the operation of the flush valves furnished and installed on the project.
- E. It is the Contractor's responsibility to turn over to the owner all fixtures and floor drains in a clean condition.

220022 PAINTING

- A. The Contractor should note that plumbing piping may be exposed in various areas. The contractor should specifically note that all exposed cast iron piping be uncoated.
- B. All exposed plumbing pipe and plumbing pipe insulation in areas other than mechanical rooms shall be left clean and free from oil ready for painting by the General Contractor. All finished painting will be by the General Contractor with colors to match the surrounding areas.

220023 ELECTRICAL WIRING

- A. The Electrical Contractor shall furnish and install all disconnects and motor starters and circuitry. Plumbing Contractor shall make all final electrical connections to equipment provided under Division 22. See Electrical Drawings.
  - 1. EXCEPTION: Plumbing Contractor shall provide Aquastat(s) as indicated on Contract Drawings and in "CONTROLS" section of Division 22 specifications. The Plumbing Contractor shall be responsible for Aquastat wiring connections.

220024 CONTROLS

- A. General:
  - 1. The Plumbing Contractor shall provide a 120-volt, 24-hour, 7-day programmable time clock, and wire the time clock to the hot water circulation pump. Time clock shall be located in the same room as the circulation pump.
  - 2. All electric wiring in connection with the temperature controls and all interlock wiring shall be furnished under this section of the specifications. The wiring shall be installed by licensed electricians employed by Contractor in strict accordance with all local, State, and National Codes. All control and interlock wiring whether line or low voltage shall be run in EMT conduit or as specified under the electrical section of these specifications. Installation of all concealed conduit shall be coordinated with contractor for general construction so it may be installed before slabs are poured or walls are erected.
  - 3. The control diagrams indicated on the drawings and specified herein show the intended sequences of operation of the various control systems and shall be followed as closely as practicable.

B. Temperature Sensing Devices:

1. Strap-on Aquastat shall have an adjustable range and be mounted directly on the building hot water recirculating line. Aquastat shall be set to 135°F.
2. Each water heater shall be equipped with an integral adjustable thermostat.

C. Sequence of Operation:

1. The programmable time clock shall allow the circulator pump to be powered on during pre-set hours of operation.
2. The aquastat shall energize the power circuit to the circulator pump when temperature reaches set point during hours of operation set by the programable time clock

D. Instructions and Diagrams:

1. The Contractor shall provide to the owner a complete instruction manual covering the function and operation of all control components. The manual shall also contain a schematic drawing of each control system properly marked and keyed with the equipment list to identify each item of control equipment.
2. The Contractor shall also provide a complete schematic control diagram framed under glass and mounted on the wall in the equipment room.

220025 OPERATING AND MAINTENANCE MANUAL

A. All operation and maintenance manuals **shall** be delivered by the Contractor to the Owner thru the Architect. The manuals **shall** be installed in 3-ring hard cover heavy duty notebooks with the name of the project and the words “**Operation and Maintenance Manual**” permanently affixed to the cover and spine. All items for the project shall be separated by identification tabs correlated to the index. The manuals **shall** contain the following items as a minimum:

1. Index and page number.
2. Certificate of substantial completion.
3. A summary sheet of warranties with dates noted and a copy of all warranties.
4. List of subcontractors and suppliers with names, addresses, and phone numbers.
5. Water Line test data for sterilization.
6. Backflow preventer certificate of operation.
7. Complete start-up, operation, and shutdown procedures for each system including sequence of events, locations of switches, emergency procedures, and any other critical items
8. Lubrication schedules and types of lubricants.
9. Complete set of current shop drawings and equipment description showing all capacities and other operation conditions.
10. Equipment summary showing all capacities and ratings (HP, KW, etc.).
11. Operation manuals, installation manuals, and parts list for all installed equipment.
12. All submittal data indexed with tabs and shop drawings.

B. One copy shall be manufacturer’s original published literature with manufacturer’s name on all items. **FAXED COPIES WILL NOT BE ACCEPTABLE.**

220026 AS BUILT DRAWINGS

A. The General Contractor and Plumbing Contractor, shall maintain “during the course of the work” a set of drawings marked up to show the work as installed, including dimensions to and elevations of buried work. Both Contractors shall initial and date all changes to the contract drawings. The Architectural Observer may check this set of documents monthly for compliance. Upon completion of the work, return this set of drawings to the Architect.

220027    FIXTURES

- A. All exposed piping and metal parts shall be chrome plated. Slip joints will not be permitted except on fixture side of trap. Rigid supplies are specified for fixtures and it is intended that they be installed true and plumb from fixture to wall rough in. Connections for water closets shall be made by use of flanges compatible to waste piping materials and verminproofed wax gaskets.
- B. **MANUFACTURER'S MODEL NUMBERS ARE PROVIDED FOR GENERAL INFORMATION ONLY.** Description of product shall take precedence over model numbers.
- C. All floor drains, floor sinks, and mop receptors shall have a deep seal P-trap installed below floor as a separate item. Joint connection shall be compatible to piping system.
- D. All floor-mounted water closets shall be set and grouted with white grout between floor and closet base.
- E. All wall-hung lavatories shall be sealed between wall and fixture with white or clear "G.E. Silicone Seal" caulking.
- F. All electric water coolers shall be sealed between wall and fixture with clear "G.E. Silicone Seal" caulking.
- G. All mop receptor basins shall be sealed between wall and fixture with clear "G.E. Silicone Seal" caulking.
- H. All counter mounted fixture rims shall be sealed with clear "G.E. Silicone Seal" caulking.

WC-1    **WATER CLOSET:** (Adult ADA) Floor mounted, 16-17" high vitreous china, closed coupled, tank type, high-efficiency, 1.28 GPF elongated bowl with china caps and bolts, antimicrobial glaze, Sloan WETS 4029.4010-STG or approved equal by Zurn or American Standard. Provide tank flush lever to operate from the wide side of toilet compartment side. Chrome plated flexible riser with wheel handle stop, chrome plated wall supply, chrome plated cast brass escutcheon with setscrew, McGuire No. 169, or approved equal by Zurn or Brasscraft. White moltex open front seat with concealed stainless steel check hinge, less cover, with integrated lifting lip, shall be Kohler K-4731-SC or approved equal.

L-1    **LAVATORY:** (Adult ADA) 20" by 18" vitreous china bowl with single center set punching, back ledge, self -draining deck, wall hanger, and front overflow shall be Zurn Z5361, Sloan SS-3103, or Kohler K-2006. Single lever, chrome plated, ceramic cartridge, lead free supply faucet with 0.5 GPM vandal resistant aerator, and stainless steel braided hose supplies, shall be Zurn Z82200-XL-3M, Chicago Faucets 2200-E2805ABCP, or T&S Brass B-2701-VF05. Thermostatic lead free mixing valve with locking set point, 3/8" inlet check stops, 3/8" outlet, shall be installed under the lavatory to supply 110 F tempered water to the faucet. Mixing valve shall conform to ASSE 1070 or CSA B125.3 and shall be Watts Model LFUSG-B or approved equal by Combraco or Heatguard. Chrome plated lead free angle stops with loose key handle and 1/2" chrome plated nipple to wall and escutcheon with set screw shall be McGuire or approved equal by Zurn or Brasscraft. Chrome plated cast brass strainer with open grid, overflow openings, cast brass locknut and 1-1/4" 17 gauge tailpiece shall be McGuire, Zurn, or Engineered Brass Company. 1-1/4" by 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/4" slip in inlet, cleanout, ground joint, 1-1/2" I.P.S. outlet, shall be McGuire, Zurn, or Engineered Brass Company. 1-1/2" chrome plated nipple to wall with escutcheon and setscrew shall be McGuire, Zurn, or Engineered Brass Company. Chair carrier with floor anchor plate, upright supports, and bearing plate shall be Zurn Model Z-1224, J. R. Smith Model 0800 or approved equal by Watts. Lavatory shall be mounted at height as shown on the drawings. Lavatory supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or Mainline.

- HB-1 WALL HYDRANT: Non-freeze type with 3/4" copper inlet, 3/4" double check end, removable key handle, self draining, for wall thickness as required, Woodford Model Zurn Model Z-1310 or Josam Model 71050-12.
- HB-2 HOSE BIBB: Wall mounted, polished chrome plated brass with 3/4" vacuum breaker hose end, locking shield, tee handle, 1/2" inlet wall flange, Woodford Model 26P-1/2, Mifab MHY-9240, T & S Brass B-0702/B-972 or Preir C-257CP.50.
- FD-1 FLOOR DRAIN: Cast iron body drain with 2" outlet to match piping system, 6" round nickel bronze heelproof top, with flashing device, concrete shield, post pour vertical and tilt adjustment, Zurn ZN415-BZ1, or approved equal by Watts or Sioux Chief.
- FD-2 FLOOR DRAIN: Cast iron body drain with 4" outlet to match piping system, 6" round nickel bronze heelproof top, with flashing device, concrete shield, post pour vertical and tilt adjustment, Zurn ZN415-BZ1, or approved equal by Watts or Sioux Chief.
- FS-1 FLOOR SINK: 12" x 12" x 8" deep cast iron body floor sink with 3" outlet to match piping system, anchor flange, white acid resistant enameled interior, white acid resistant dome strainer, half nickel bronze grate, Zurn Z-1901-K-2-33, or approved equal by Josam or J. R. Smith.
- TD-1 TRENCH DRAIN: 14 gauge galvanized steel drain system with 1" slot opening, drain sections to match length(s) shown on drawings, end caps, sump adapter plate, removeable silt strainer, 1/4" checker plate rated for h20 loading, and sump with 4" double inlet and 4" outlet, by U-Drain or approved equal by Zurn or Watts.
- SK-1 UTILITY SINK: Free standing, single compartment, stainless steel sink with 24" by 24" by 12" deep compartment, less drain boards, coved corners, sloping top rim, 8" high backsplash, center drain outlet, overflows, stainless steel legs, adjustable bullet shaped feet, 8" center faucet openings, Just Model NSFB-124 or approved equal by Elkay, Advance Tabco or Amtekco. Sink compartment shall be equipped with roto-handle waste fitting with overflow, 1-1/2" outlet, stainless steel strainer, Elkay LK86RT. Wall mounted, polished chrome plated supply faucet with top brace, vacuum breaker, integral screwdriver shank check stops, 3/4" hose end, T&S B-0665-BSTP, Chicago 540-LD897SWXFXKCAB or approved equal by Zurn. Thermostatic lead free mixing valve with locking set point, 3/4" inlet check stops, 3/4" outlet, shall be installed under the sink to supply 120 F tempered water to the faucet. Mixing valve shall be ASSE 1070 approved and shall be Watts Model LFMMV or approved equal by Combraco or Heatguard. 1-1/2" x 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/2" slip joint inlet, cleanout, ground joint, 1-1/2" I.P.S. outlet shall be McGuire No. 8089C, Zurn Z8712-PC-B, or K-8996. Sink supplies shall be installed using 1/2" type 'L' hard copper equipped with ball valve stops. Install chrome plated cast brass escutcheons on all piping leaving the wall.
- SK-2 BREAKROOM SINK: (ADA) 30-1/2" x 18-1/2" x 5-1/2" deep bowl single compartment, 18-gauge, type 304 (18-8) nickel bearing stainless steel undermount sink with sound deadening applied to under side shall be Acorn SUADA-2816 customized with front overflow or approved equal by Elkay, Just or Advance Tabco. Stainless steel crumbcup strainer with 1-1/2" offset tailpiece shall be Elkay LKAD35 or Just J-ADA-35 GR or approved equal by Advance Tabco. Lead-free hot and cold water supply faucet with renewable cartridge, 8" L-type swing spout, 1.5 GPM soft flow aerator, less spray, shall be Chicago 1100-E35ABCP, Zurn Z871G3-XL-18F, or approved equal by Delta. Thermostatic lead free mixing valve with locking set point, 1/2" inlet check stops, 1/2" outlet, shall be installed under the sink to supply 110 F tempered water to the faucet. Mixing valve shall be ASSE 1070 approved and shall be Watts Model LFMMV or approved equal by Combraco or Heatguard. 1/2" sweat x 1/2" compression sink supply stops shall be equipped with 5" extension, wheel handle ball valve angle stops shall be McGuire, Zurn, or Brasscraft. 1-1/2" x 1-1/2" chrome plated adjustable cast brass P-trap with 1-1/2" slip joint inlet, cleanout, and 1-1/2" 17-gauge tube outlet shall be McGuire, Zurn, or Kohler. Install cast

brass escutcheons with setscrew on all piping entering base cabinet. Supplies and trap shall be protected by A.D.A. approved premolded insulation assembly as manufactured by Truebro, McGuire or Mainline.

- CB-1 ICE MAKER CONNECTION BOX: Fully recessed unit with lead free cold water shut-off valve, compression nut and ferrule as shall be LSP Products Group model OB-801-LL, IPS Corporation model AB9700 or approved equal Oatey Company.
- EWC-1 ELECTRIC WATER COOLER: (Dual Height) Wall mounted, dual height, vandal resistant, air cooled type cooler with stainless steel anti-splash receptor, stainless steel cabinet, in line 'Y' strainer, anti-squirt dual stream bubbler, automatic stream regulator, push controls on front, hands free bottle water filler, wall hanger, sealed hermetic compressor with capacity of 8-GPH of 50°F drinking water at 90°F room temperature and 80° F inlet water temperature, Elkay LVRCGRNTL8WSK, Halsey Taylor HTHB-HVRGRN8BL-WF, or approved equal by Murdock or Oasis, factory wired for 115 volt, single phase electrical service. Chair carrier with steel upright support legs, backing plates shall be Zurn Z-1225-BL, or approved equal by J.R. Smith or Watts. The Plumbing Contractor shall furnish the electrical receptacle rough-in dimensions to the Electrical Contractor to provide for a concealed electrical service to the unit. Plumbing Contractor shall provide PVC P-trap the same size as the electric water cooler drain. Wheel handle lead free stop valve shall be McGuire LF175 or approved equal. Plumbing Contractor should note that spout should be set at height as shown on the drawings.
- MR-1 MOP RECEPTOR: 24" x 24" x 12" deep precast terrazzo receptor with 3" inside caulked drain, stainless steel strainer, stainless steel caps on threshold, Fiat Model TSB3010, or approved equal by Williams or Mustee. Wall mounted, polished chrome plated supply faucet with top brace, vacuum breaker, integral screwdriver shank check stops, 3/4" hose end, T&S B-0665-BSTP, Chicago 540-LD897SWXFXKCAB or approved equal by Zurn. Heavy duty, cloth reinforced rubber hose and hose hook, Fiat Model 832-AA, or approved equal by Williams or Mustee. Wall mounted, 24" long, 3 mop spring clip hanger, Fiat Model 889-CC, or approved equal by Williams or Mustee. Stainless steel wall guards with corner bracket shall be Fiat Model MSG 2828 or approved equal Williams, or Mustee. Supply faucet outlet shall be mounted above stainless steel wall guards. Contractor should note that joint between receptor, wall and floor should be sealed with clear silicone sealant.
- HD-1 HUB DRAIN: Provide 3" I.D. PVC hub drain for condensate collection from HVAC equipment. Hub drain shall extend to 1" above finished floor. Pipe material shall be per condensate drainage section of these specifications. Support shall be per hangers section of these specifications.
- EEW-1 EMERGENCY EYE WASH: Wall mounted, galvanized steel, barrier free emergency eye wash unit with stay-open chrome-plated brass valve, stainless steel push handle activation with self-activating flip open dust covers, integral 5.1 GPM flow control at 30 psi, impact resistant ABS plastic sprayheads, yellow impact resistant ABS plastic bowl and dust cover, unit shall comply with ANSI Z358.1, Bradley Series S19224 or approved equal by Guardian or Speakman. Plumbing Contractor shall install 1-1/4" schedule 40 PVC P-trap and drain pipe to drain outlet and hard pipe the drain. Plumbing Contractor shall furnish and install thermostatic mixing valve with inlet screwdriver check stops, outlet thermometer and low temperature adjustment range. Valve shall be designed to provide a minimum of 15 minutes of cold-water flow should hot water supply fail. Mixing valve shall be Bradley Model S19-2000-RS-EFX8 or approved equal by Guardian or Speakman, mounted in recessed stainless steel cabinet at height indicated on drawings.
- WH-1 WATER HEATER: Factory assembled electric 10-gallon storage type heaters shall be equipped with glass lined steel tanks, ASME pressure temperature relief valve, magnesium anode rod, tank drain with hose connection, ASHRAE/IESNA 90.1 insulated factory applied baked enamel finish jacket, single bolt-in, 2,000-watt immersion element and control box. Heater shall be



controlled by immersed bulb thermostat and be equipped with high limit temperature control, control box, transformer, contactors and junction box. Control circuits shall be a maximum of 120-volts. Heaters shall be U.L. listed and shall carry 3-year factory warranty. Heater shall be factory wired for 120-volt, single-phase electrical service as shown on the plans and shall be A.O. Smith Dura-Power DEL-10, or approved equal by State, or Rheem. Water heater shall be started by the manufacturer's factory representative.

WH-1A WATER HEATER: Factory assembled electric 30-gallon storage type heaters shall be equipped with glass lined steel tanks, ASME pressure temperature relief valve, magnesium anode rod, tank drain with hose connection, ASHRAE/IESNA 90.1 insulated factory applied baked enamel finish jacket, two bolt-in, 6,000-watt immersion elements set for non-simultaneous operation and control box. Heater shall be controlled by immersed bulb thermostat and be equipped with high limit temperature control, control box, transformer, contactors and junction box. Control circuits shall be a maximum of 120-volts. Heaters shall be U.L. listed and shall carry 3-year factory warranty. Heater shall be factory wired for 240-volt, single-phase electrical service as shown on the plans and shall be A.O. Smith Dura-Power DEL-30, or approved equal by State, Mor-Floor or Rheem. Water heater shall be started by the manufacturer's factory representative.

WH-1T WATER HEATER: Shall be electric instantaneous type, 4,600 watt immersion heating element, with microprocessor controlled outlet temperature. Thermostat shall be factory set for 110 degrees. Heater shall be wired for 240-volt, single-phase operation and shall be Chromomite Laboratories, Inc. Model E-46L/240.

220028 GUARANTEE

- A. Guarantee: The Contractor shall guarantee the entire plumbing system subject to the General Conditions of these specifications.

220029 BIDDING PROCEDURE

- A. The Contractor shall provide bidding for Alternate Bids in accordance with Division 1. Contractor shall refer to Division 1 for any required unit prices and allowances.
- B. The Contractor shall quote the amount to add or deduct from his Base Bid to provide Rexarc manifolds and station drops.

END OF SECTION 220000

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## SECTION 230500 - HEATING AND AIR CONDITIONING

### 230501 GENERAL

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. The Heating and Air Conditioning Contractor shall cooperate with the contractors of other trades and shall install his work as fast as the progress of the balance of the work will permit.
- C. See Section 013100 for requirements for Coordination Drawings.
- D. The Heating and Air Conditioning Contractor shall install all work in accordance with the requirements of the North Carolina State Building Code. Codes to be a part of these specifications: North Carolina State Building Code, National Fire Protection Association Codes Section 70, 90A, 91 and other applicable sections.
- E. Inspection by local authorities will be required.
- F. The drawings accompanying these specifications indicate diagrammatically the general location of the ducts, piping, and equipment and do not show all offsets, supports, fittings, bolts, connections, etc., required for a complete system. While the drawings are to be followed as closely as possible, if it is found necessary to change the location of same to accommodate the conditions at the building, such changes shall be made without additional cost to the Owner, and as directed by the Engineer. Any detail which is omitted, and which is necessary for the proper operation of any system included under the contract, shall be supplied and installed by the Heating and Air Conditioning Contractor without extra cost to the Owner. All pipes and ducts shall be run as high as possible to maintain ceiling and head clearance. All equipment shall be installed in such a manner as to allow proper maintenance access.
- G. Equipment and Materials shall be delivered to the site and stored in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. All items subject to moisture damage shall be stored in dry spaces.
- H. Conditions shall be checked at the building before placing orders for apparatus and such apparatus shall be of such dimensions as to fit the spaces allotted. The Heating and Air Conditioning Contractor shall not scale mechanical plans, but rather refer to architectural plans for dimensions.
- I. By signing the Contractor's Proposal, it is understood and agreed that the Heating and Air Conditioning Contractor has, by careful examination, satisfied himself with the quantity, quality, and location of all excavation materials to be encountered in his contract. No additional payment will be approved for well pointing or any other existing conditions encountered. Refer to Division 31 for site work requirements.
- J. All debris resulting from heating and air conditioning work shall be removed from the premises daily or as directed by the Engineer. Trash and rubbish shall not be allowed to accumulate either within or outside the building. Materials and debris, which in the opinion of the Engineer cannot practicably be removed from the site the same day, may be temporarily stacked or stored in a designated location on the site as directed by the Engineer.
- K. Guards shall be provided for all moving equipment, motor couplings, pump shafts, belt drives and similar exposed reciprocating or rotating components.
- L. All HVAC and refrigeration equipment shall be labeled in accordance with Section 301 of the North Carolina Mechanical Code and as required by the Authority having jurisdiction. Labeling shall be a permanent factory-applied nameplate affixed to the equipment on which shall appear in legible lettering, the manufacturer's name or trademark, the model, serial number, and the seal or mark of the testing agency.

230502 SCOPE

- A. The Heating and Air Conditioning Contractor shall provide labor and materials required for a complete system ready for operation as shown on the drawings and hereinafter specified. This includes all equipment, ductwork, necessary plumbing, and all other services necessary whether they are specifically mentioned herein or not. The entire installation shall be installed in a first-class, neat, professional manner to the satisfaction of the Engineer and shall conform to all applicable codes and laws.

230503 SHOP DRAWINGS AND SUBMITTAL DATA

- A. The Heating and Air Conditioning Contractor shall submit within 10 days after award of the contract a list of materials and the manufacturer to be used on this project. He shall submit within thirty days after award of the contract at least five copies of submittal data in written form for the Engineer's use in approving materials and equipment. One copy will be returned. If the Heating and Air Conditioning Contractor desires the return of more than one copy, additional copies shall be provided to the Engineer at the time of the original submission. It is requested that all submittal data be sent to the Architect at one time. Unless special consideration is given, none of the submittal data will be checked until it has all been received by the Architect. Where called for, the Heating and Air Conditioning Contractor shall submit five sets of shop drawings showing the detailed arrangement or connections that are shown schematically on the drawings. Data certified for the specified project and indicated manufacturer, type, or size, capacity, etc., shall be submitted for the following equipment items:

1. Split System Heat Pumps
2. Ductless Split System Heat Pumps
3. Radiant Heaters
4. Power Ventilators and Gravity Ventilators
5. Diffusers, Grilles, and Registers
6. Heaters
7. Controls with Complete Diagram
8. Manual, and Motorized Dampers
9. Equipment Vents
10. Access Doors
11. Insulation
12. Through-Penetration Firestop Details
13. Testing and Balancing

230504 APPROVED EQUAL EQUIPMENT, ETC.

- A. Manufacturers listed are to establish a standard of quality and not intended to limit the selection to these manufacturers. All materials and equipment which are essential and have not been specified or shown shall be new and of the highest grade and quality, free from defect or other imperfections. It should be understood that where the word "provide" is used, it is intended that the Heating and Air Conditioning Contractor shall purchase and install all materials required. Approval of equipment will not relieve the Contractor of compliance with the specifications even if such approval is made in writing, unless the attention of the Engineer is called to the non-complying features by letter accompanying the submittal data. Approval of submittal data by the Engineer shall not be construed as a complete check of approval of detailed dimensions, weights, gauges, and similar details with the proposed articles. The conformance with the necessary coordination between the various other contractors and suppliers shall be solely the responsibility of the Heating and Air Conditioning Contractor.

230505 SPLIT SYSTEM HEAT PUMPS

- A. Air handling unit section shall be UL or ETL labeled draw-thru design complete with centrifugal fans, condensate drain pan, refrigerant coil, insulated cabinet, electric resistance auxiliary heaters, and filters. Coil shall be dual circuit where indicated with non-ferrous tubes mechanically bonded to plate fins. The

fan section shall have direct driven forward-curved fans with variable speed adjustment. The cabinets shall be internally insulated and shall be constructed of 16-gauge galvanized steel with baked enamel finish. Auxiliary electric strip heaters shall be by the heat pump manufacturer and shall be UL or ETL approved to be installed in the unit in the reheat position or at the unit's discharge. Unit shall rest on pad-type vibration isolators.

- B. Filters shall be 2" thick UL Class 1 pleated panels with Minimum Efficiency Reporting Value/MERV 13 per ASHRAE Standard 52.2-1999. Contractor shall supply complete sets of filters to protect his equipment during construction, another change of filters at completion, and leave one additional complete set of filters at the building for the next change. Provide factory supplied fixed filter blockoffs to prevent air bypass around filters.
- C. Outdoor section shall be UL labeled and AHRI rated and certified with its air handling unit and bear the AHRI seal. The fans shall be permanently lubricated, direct drive, propeller type. The compressors shall be hermetic using R-410A refrigerant with suction and discharge stop valves, crankcase heaters, automatically reversible oil pump, oil filter, internal thermostat, and controls for low ambient temperature operation. The unit controls shall include compressor staging, a high and low pressurestat of the automatic reset type, a positive acting five minute timer to prevent short cycling and a motor starting and protecting equipment. Units shall be furnished with coil guards.
- D. See GUARANTEE 230534 for description of unit and compressor warranty requirements.
- E. Refrigerant piping systems shall be sized, pitched, and furnished with all specialties as recommended by the unit manufacturer to accommodate refrigerant piping lengths. Specialties shall include suction line accumulators, liquid line solenoid valves, thermal expansion valves, refrigerant sight glass, removable core filter drier, and any other item deemed necessary or recommended by the unit manufacturer.
- F. Indoor and outdoor sections shall be by the same manufacturer and shall be Trane, Carrier, JCI/York, or approved equal.

#### 230506 DUCTLESS SPLIT SYSTEM HEAT PUMPS

- A. Indoor section shall be vertical wall, ceiling cassette, or ceiling mounted ductless type split heat pump unit as indicated on the drawings. Unit cabinet shall be 20 gauge-galvanized steel with rounded corners and finished with an undercoat and topcoat of hard finish polyurethane paint. Unit shall be internally insulated and be furnished with auxiliary heater and 1" thick pre-cut washable polyester filter media. Contractor shall supply sets of filters to protect equipment during construction, another change of filters at final completion, and leave an additional complete set of pre-cut filters at the building for the next change. Unit fan shall be dual tangential blower type. Unit shall have remote mounted condensate pump. High condensate limit switch shall deenergize unit if condensate pump fails to function.
- B. Unit shall have hardwired wall-mount temperature controller with high-medium-low fan control.
- C. Outdoor section shall be by the same manufacturer as the indoor section. Units shall be compact low profile type with inverter driven compressor, R410A refrigerant, crankcase heaters, and controls for low ambient temperature operation in cooling mode down to 0°F. The fans shall be permanently lubricated, direct drive, side discharge type. Safety controls shall include loss of charge and low and high pressure switch.
- D. Outdoor section coils shall have factory seacoast coating.
- E. Systems using A2L refrigerant shall be listed to UL Standard 60335-2-40, current edition.
- F. Per EPA SNAP 23, systems using A2L refrigerant shall have permanently affixed markings and labeling to indicate refrigerant installed in the system and Notice of leak detection system installed, and shall have service ports, pipes, hoses and other devices through which refrigerant flows to be marked in red.

- G. Systems using A2L with refrigerant charge > 4.0 lbs in largest independent circuit shall have integral factory installed refrigerant leak detection system mounted in the air handling unit section downstream of the evaporator coil with internal controls to automatically upon refrigerant detected, unit commands compressors and electric heat (if present) off, and commands air handling unit's fan to maximum airflow for air circulation. Once refrigerant has not been detected for a minimum of 5 minutes, unit shall return to normal operation.
- H. For systems using A2L refrigerant, if releasable refrigerant charge in the system exceeds the levels allowed in ANSI/ASHRAE Standard 15 – 2022 or newer for the effective dispersal volume, provide safety isolation valves in both refrigerant lines as release mitigation controls. Valves shall automatically close upon signal from the unit integral refrigerant leak detector. Valve locations shall be as such for releasable refrigerant charge to be less than the levels allowed in ANSI/ASHRAE Standard 15 – 2022 or newer for the effective dispersal volume.
- I. As part of submittals, provide calculated releasable refrigerant charge in largest independent circuit for each system, including connecting piping.
- J. See GUARANTEE 230534 for description of unit and compressor warranty requirements.
- K. Refrigerant piping systems shall be sized, pitched, and furnished with all specialties as recommended by the unit manufacturer to accommodate refrigerant piping lengths. Specialties shall include suction line accumulators, liquid line solenoid valves, thermal expansion valves, refrigerant sight glass, removable core filter drier, and any other item deemed necessary or recommended by the unit manufacturer.
- L. Units shall be UL or ETL labeled and shall be Daikin, Mitsubishi, Trane, Sanyo, Friedrich, LG, or approved equal.

#### 230507 RADIANT HEATERS

- A. Heaters shall be infrared tube type. Heaters shall be equipped with a 24-volt direct spark ignition with automatic 100% shutoff system. The heater controls shall include a pressure switch designed to provide complete unit shutoff in the event of combustion air or flue blockage. The heaters shall be equipped with an on-line diagnosis monitoring light system. The three lights shall monitor the power to the heater, insufficient air flow, and the spark ignition and the combination gas valve operation. The heater's burner shall consist of a heavy-duty cast iron atmospheric burner. The flame characteristics shall be highly luminous for maximum radiant heat transfer through the emitter tube wall. The heater's emitter tube shall operate at an average surface temperature of 750°F and shall be made of 16-gauge, aluminized steel for long life (4" O.D.). The emitter tube shall be calorized for longevity, corrosion resistance, and high radiant efficiency. The measured surface emissivity shall be 0.83 - 0.86 at operating temperature.
- B. Heaters shall operate under negative pressure at all times during operation. The heater exhaust assembly shall include a 115-volt draft inducer. The draft inducer shall be equipped with a permanently lubricated, totally enclosed and shielded, fan cooled, and heavy duty ball bearing motor. The motor shall no require maintenance or lubrication for the life of the unit. The draft inducer assembly shall be capable of rotating 90° for vertical or horizontal venting. The heaters will be A.G.A. and C.G.A. design certified for vertical or horizontal venting, maximum 75 feet horizontal sidewall venting, and for 50 feet outside combustion air inlet duct. There shall be no draft hoods. The combustion chamber shall be totally enclosed. The heaters shall utilize factory assembled, highly efficient aluminum reflectors with a reflectivity of 97.5%. The reflector ends shall be enclosed for maximum radiant heat output and minimum convection losses. The heaters shall be factory assembled and tested. The heaters shall not require any field wiring or adjustments to assure maximum performance and safety. Heaters shall operate satisfactorily in any position from horizontal to forty-five degrees (45°) from horizontal, and incline mounted up to 2/12 pitch, and shall be suitable for vented/indirect vented applications. Heaters shall be designed to operate on natural gas.

- C. Heaters shall be design certified by the American Gas Association and the Canadian Gas Association. The manufacturer shall provide a written limited warranty covering the heavy one-piece cast iron burner for a period of ten (10) years, the emitter tube for a period of five (5) years and all components utilized in the heater's control assembly for a period of one (1) year.
- D. Heaters shall be Space-Ray model LTU, Schwank, or approved equal.

#### 230508 POWER VENTILATORS AND GRAVITY VENTILATORS

- A. Power ventilators shall be tested and rated in accordance with the standards of AMCA 210 and shall carry the AMCA seal. All fans shall be UL labeled. Fans shall be Cook, Greenheck, Carnes, Twin City, PennBarry, or approved equal.
- B. Ceiling exhaust fans shall have plug disconnect switch, interior fiberglass insulation, forward curved centrifugal blower wheel, back draft dampers, permanently lubricated motor, and white steel grille. Units shall have solid-state motor speed controller with an "OFF" position. Furnish wall cap with birdscreen where shown on drawings. Caps shall have baked enamel finish of color selected by the Architect.
- C. Wall mounted fan shall be heavy duty belt driven with steel propeller, exhaust or supply as indicated on the drawings. Fan shall be manufactured at an ISO 9001 certified facility, shall be UL listed and bear the AMCA certified rating for sound and air performance. The fan shall be bolted and welded construction with the motor, bearings and drive mounted on a tubular steel power assembly. All steel components shall have an electrostatically applied baked polyester powder coating. Propeller shall be steel and shall be balanced in accordance with AMCA Standard 204-96. Motor shall be heavy duty permanently lubricated sealed ball bearings in a cast iron pillowblock housing for a minimum L 50 life in excess of 200,000 hours. Drives shall be variable pitch and sized for 150% of installed motor horse power. Fan shall be complete with OSHA wire guard, heavy duty galvanized motorized shutter in a wall collar ready for connection to the wall louver.
- D. High Volume Low Speed (HVLS) Air Movement Fans shall be four blade minimum of diameter indicated on the drawings. Formed aluminum blades and hub shall have polished finish with powder coated finish of color selected by Architect on motor frame and gear reducer cover. Each fan shall have three-way motor-to-hub safety connection. Entire assembly shall be rotationally balanced. Fan's sound shall be less than 50 dBA measured 20 feet below and 20 feet from fan's center. Full CFM performance shall be tested to ANSI/AMCA 230. Fan shall include factory structure mounting kit and fan variable speed, on/off, forward/reverse remote mounted controller. Fan's factory warranty shall be 3-year parts, 1-year labor, 10-year structural, and lifetime on blades and hub workmanship. Fans shall be installed by manufacturer trained technician. Basis of design fans are Rite Hite Revolution.
- E. Gravity ventilators shall be heavy gauge aluminum and factory aluminum finish. Mounting base shall be prepunched and include an integral spun venturi. The internal structure shall be constructed of galvanized steel for rigid support and includes a windband and birdscreen. Bird screen shall be 1/2" x 1/2" PVC coated wire.
- F. Roof curbs for roof-mounted equipment shall be provided by the Heating and Air Conditioning Contractor. It shall be the responsibility of the Heating and Air Conditioning Contractor to give the proper locations and sizes required for all roof openings. Opening will be framed and cut by not the Heating and Air Conditioning Contractor. Roof curbs shall be insulated. Equipment shall be attached to roof curbs with a minimum of two stainless steel fasteners and EPDM washers on each side of roof curb.

#### 230509 DIFFUSERS, GRILLES, AND REGISTERS

- A. Diffusers, Grilles, and Registers shall be as manufactured by Carnes, Metal Aire, Titus, Krueger, Price, Duct Sox, or approved equal unless otherwise noted.

- B. All diffusers, grilles, and registers shall have a maximum NC level of 25 in the space for the specified airflow, and shall have factory applied white baked enamel finish. Where indicated on drawings to be field painted, white factory finish shall be as necessary to receive field finish painting.
- C. Lay-In Supply Air Diffusers: Shall be steel construction, fixed square louvered face, 4-way blow, panel border to drop in 24" x 24" "T" bar ceiling grid, with adjustable vertical pattern. Vertical air adjustment shall be made by adjusting four perimeter blades to force air down in a vertical position.
- D. Regular Ceiling Supply Air Diffusers: Shall be steel construction square, fixed square louvered face, 4-way blow, panel border, adjustable vertical pattern, and opposed blade damper.
- E. Sidewall Supply Air Grilles and Registers: Shall be steel with adjustable front vertical and back horizontal airfoil vanes on 2/3" centers. Registers shall have opposed blade dampers.
- F. Lay-in Ceiling Return Air Grilles: Shall be aluminum 1/2" x 1/2" egg crate with steel frame and designed to lay in an inverted "T" bar ceiling grid. Grilles shall be full flow across the entire face of grille and tapered up to neck size.
- G. Ceiling Return Air Registers: Shall be aluminum 1/2" x 1/2" egg crate with steel frame and opposed blade dampers. Registers shall be full flow across the entire face of register and tapered up to neck size.

#### 230510 HEATERS

- A. Electric unit heaters shall be listed by Underwriters Laboratories, Inc., and shall bear the appropriate UL label. Heaters shall be furnished and installed in accordance with the manufacturers' published recommendations. The elements shall be metal sheath fintube type. Heaters shall be complete with adjustable discharge louvers, ceiling mounts, built-in contactors with 24 volt control circuit, built-in fuses, 18 gauge steel cabinet, built-in thermal overload protection, combination fan guard and motor mount, continuous duty motor, unit mounted thermostat, and separate field installed-unit mounted power disconnect switch. Unit heaters shall be Markel Series 5100, Raywall, Indeeco, or approved equal.
- B. Electric baseboard heaters shall be commercial-grade furnished and installed complete with all necessary heating elements, brackets, and closures, splice plates, interior and exterior corners, and accessible wiring compartment. Maximum leaving air temperature at the outlet and enclosure surface temperature, under continuous operation, shall not exceed 200°F. Heaters shall be Markel Series 2900C, Q-Mark, Raywall or approved equal complete with UL label.

Heating elements shall consist of stainless steel element rod with aluminum fins. Maximum watt density per linear foot of element shall not exceed 250 watts. Enclosures shall be steel with thicknesses not less than 18 gauge front and 22 gauge back and shall be rigidly reinforced. Enclosures shall be wall hung with bottom at elevation above the finished floor as shown on the drawings, and shall be suitable for the space available. End plates and corner pieces shall be die formed with round edges, fit flush with enclosure surface, and be neat in appearance. No direct contact between enclosure and heating element will be permitted. Enclosure shall be painted with rust-inhibiting paint at the factory and shall have baked enamel finish of color selected by Architect. Connection box shall be designed to permit power supply and control wiring from bottom, rear, right or left side as required. Thermostat shall be built-in double pole double throw adjustable with extra sensitive bulb and capillary. Thermostat shall have positive off position and be within unit enclosure or junction box. Limit controls shall be continuous end-to-end automatic reset thermal overload; line voltage protection shall be provided with each individual baseboard heater to protect from overheating due to any cause. Baseboard unit shall be furnished complete, factory prewired and ready to receive branch circuit and connections. Each heater shall be provided with a factory-installed safety disconnect switch or circuit breaker installed in the housing or in an auxiliary matching control section or have thermostat with positive off position.



230511 CONTROLS

- A. See Section 230900 Instrumentation and Control for HVAC.

230512 MANUAL, AND MOTORIZED DAMPERS

- A. Manual and Motorized dampers shall be low leakage type provided in the duct systems as indicated on the drawings in accordance with NFPA Standard No. 90A and shall conform to NFPA Standard No. 90A for materials and workmanship. Blades shall have extruded vinyl double edge seals. Jambs shall have flexible metal compression type seals. Maximum damper leakage shall be 0.5% at pressure differentials under 4.0 in w.g. Leakage ratings shall be when tested in accordance with AMCA Standard 500. Motorized dampers shall have electric operators and shall be normally closed, unless indicated otherwise on the drawings. Wiring to operators shall be by the Heating and Air Conditioning Contractor. Manual dampers shall have handle and locking quadrant. To facilitate service access and insulation installation, manual damper handles shall be on 2" stand-off brackets. Handles shall be spray painted red. Dampers shall be installed according to the manufacturer's recommendations. Dampers shall be Ruskin, Pottorff, Prefco, Air Balance, United Enertech, or approved equal.

230513 ACCESS DOORS

- A. Access doors shall be provided for access to all fire and motorized dampers, duct mounted smoke detectors, and duct systems as necessary.
- B. Duct mounted access doors shall be constructed of No. 22 US gauge zinc-coated sheet steel and shall be gasketed, air tight and provided with not less than two (2) cam-type latches. Doors shall be square and shall be 12" x 12" or two inches less than the height of the duct. Doors shall be two-piece with 1" rigid insulation between the metal sides. Doors shall have engraved plastic laminated labels with 1/2" tall letters indicating item accessed through door.
- C. Wall and ceiling access doors shall be provided as specified in Section 083113.
- D. Provide 3/4" diameter red dot on ceiling grid below all duct access doors.

230514 ELECTRICAL

- A. Electrical circuit sizes are based on capacities of the drawings and it shall be the responsibility of Heating and Air Conditioning Contractor to change any and all electrical work in order to fit mechanical equipment. Heating and Air Conditioning Contractor shall coordinate with Electrical Contractor to assure that all units are properly connected and shall check wiring prior to starting units. Any damage to units resulting from improper wiring or connections shall be the responsibility of Heating and Air Conditioning Contractor. Flexible electrical conduits shall be 18 inches in length maximum. All electrical work shall be installed in accordance with codes having jurisdiction and the Electrical Division, Division 26, of these specifications. Termination of electrical power wiring to mechanical equipment shall be as detailed on the drawings and per Division 26.
- B. Starters shall have integral 120V Control power transformer. Starters shall have holding coil for 120V control with Hand-Off-Auto switch. The starters shall be inoperative if the thermal unit is removed. All magnetic starters shall be NEMA sized with applicable melting alloy overload relays and applicable enclosure. Starters shall be GE or approved equals by Allen-Bradley, Square D, Siemens or Cutler-Hammer.
- C. All three phase motors shall be provided with phase monitoring protection.

- D. Fused disconnect switches shall be per the Electrical Division, Division 26, of these specifications.
- E. Motor Starters and Fused Disconnect Switches shall be neatly arranged, and securely fastened to walls with expansion bolts, lead shields, etc. Each starter or switch shall have its usage or letter designation indicated on its cover per the Electrical Division, Division 26, of these specifications.

#### 230515 DUCTWORK

- A. Mechanical drawings are schematic only and do not show all offsets etc. required. Heating and Air Conditioning Contractor shall familiarize himself with the complete contract documents and site conditions before fabricating ductwork. Any changes to ductwork found necessary to accommodate the conditions at the building shall be made without additional cost to the Owner, and as directed by the Engineer.
- B. During construction, interior of ductwork shall be protected. All open ends of ductwork shall be covered with self-adhesive 3 mil polyethylene film.
- C. All dimensions on the drawings are free inside dimensions.
- D. Ductwork shall be of galvanized steel with standard gauges and construction in accordance with the recommendations of SMACNA HVAC Duct Construction Standards, Metal and Flexible, Third Addition, 2005 for appropriate pressure class. Airfoil turning vanes with 1-1/8" spacing and rail support system shall be installed in all 90° elbows. Ductwork shall be cross broken on all sides and shall be supported at both ends of each joint and at 10'-0" intervals maximum with galvanized angles supported by galvanized threaded rods of sizes and spacing in accordance with SMACNA. Ductwork to be exposed shall be constructed in a first class, neat, professional manner and exposed ductwork with excessive hammer marks shall be replaced. Round supply takeoffs from trunk ducts shall be made with factory 45° entry branch rectangular to round type fittings. Provide dampers in takeoff fittings where indicated on drawings. Damper handles shall be on 2" stand-off brackets. Handles shall be spray painted red. Splitter dampers shall be provided where indicated with adjustment quadrant locking device and shall be constructed of two thicknesses of 24-gauge-galvanized steel. All components of the air distribution system shall be mechanically fastened with at least three equally spaced sheet metal screws with screws not more than on 12" centers. All duct joints shall be sealed in accordance with SMACNA Seal Class A before insulation is applied. All sealants shall meet the provisions of UL181.
- E. Final 8'-0" of the runout to the air outlet may be factory fabricated flexible ducts complying with NFPA Standard No. 90A, UL 181, and shall be UL Class 1 R-6 insulated type with foil vapor barrier. The flexible duct shall be air tight for factory test when bent to full recommended radius and under not less than 10" water gauge internal pressure and shall be limited to 8'-0" maximum length. Flexible ducts shall be supported by galvanized steel straps in accordance with SMACNA at intervals not exceeding 4'-0" and at each change of direction. Flexible ducts shall have a minimum of one support.
- F. Ductwork on exterior shall have support system of 1-5/8" galvanized steel strut stand mounted on hot dipped galvanized base plates. Stainless steel bolts, nuts and washers shall be used to attach the components together.

#### 230516 EQUIPMENT VENTS

- A. Vents for radiant heaters shall be UL listed Type B gas vent with 430 stainless steel inner liner and aluminized steel outer pipe. Venting shall include cap top, roof flashing, storm collar, roof penetration, etc. as necessary. All venting shall be of materials and installation per the unit manufacturer's instructions.

230517 PIPING

- A. The Heating and Air Conditioning Contractor shall furnish all piping and supports necessary to provide a complete system as shown or intended by the plans and specifications. All piping shall be inspected, tested, and approved before being insulated or concealed. Piping 2" and smaller shall be welded or have screwed fittings with extra heavy nipples, unless otherwise noted. Piping 2-1/2" and larger shall have welded fittings of the same material and weight as the piping in which they are installed. Pipe shall be clean, run generally parallel to the building and have all open ends closed with iron caps at all times. Eccentric reducers shall be used in horizontal runs and concentric reducers in vertical runs. All piping and fittings shall have manufacturer's identification and ASTM designation incorporated thereon.
- B. Drain pan condensate and pumped condensate piping above slab shall be Type L copper with all joints soldered with 95-5 solder where interior. Piping shall have dielectric union at connection to ferrous pipe. Drain pan condensate piping shall have a minimum slope of 1/4" per linear foot, and shall be at least as large as unit condensate connection.
- C. Refrigerant piping shall be capped and dehydrated Type "L" hard drawn copper with wrought fittings. All joints shall be brazed with silver brazing alloys according to manufacturer's published recommendations.
- D. Welding material and labor shall be in accordance with welding procedures of the American Standards Code for Pressure Piping ASA B31.9. Welders shall be fully qualified in above specified procedure, tested, and so certified by an approved Welding Bureau of Locally Recognized Testing Authority. Welding shall be electric arc or oxyacetylene welding method as approved using electrodes and rods that comply with ASTM specifications.
- E. Swing joints or loops shall be provided wherever necessary to allow for expansion of piping. Broken piping or fittings shall be removed and replaced at the Heating and Air Conditioning Contractor's expense.

230518 PIPE HANGERS

- A. All piping shall be neatly and securely supported by hangers from fire resistance rated structural elements of the building spaced in the following manner:
  - 1. Steel Piping 1-1/4" and smaller - 7'-0" O.C.
  - 2. Steel Piping 1-1/2" and larger - 10'-0" O.C.
  - 3. Copper Piping 1-1/4" and smaller - 6'-0" O.C.
  - 4. Copper Piping 1-1/2" and larger - 10'-0" O.C.
  - 5. Provide 2 hangers at each change in direction.
- B. Hangers shall be the Clevis type as manufactured by Modern Fig. 590, B-Line Fig. B 3100, or Grinnell Fig. 260 complete with hanger rods of size to conform to the type of hanger and pipe supported. Hangers shall be attached to the building by beam clamps or bolted to bar joist. At hangers provide 16" long 16 gauge galvanized sheet metal protection saddle three times the nominal pipe diameter. Under no condition shall hangers be connected directly to insulated pipe. Saddles shall be Modern Type A, B-Line Fig. B 3151, or Grinnell Fig. 167.
- C. Hangers for vertical piping shall be riser clamp design as manufactured by Modern Fig. 500, B-Line Fig. B3373 or Grinnell Fig. 261. Riser clamps shall be installed on top of each floor penetration.
- D. Condensate and refrigerant piping on roof shall be supported by EPDM rubber bases with integral pipe securement. Support shall be OMG PGM, PGS, PGTS -BK or approved equal. Walk pads under each support shall be appropriate for roof per roof's warranty requirements.

230519 INSULATION

- A. All piping and ductwork shall be inspected and tested before insulation is applied. All insulation shall meet UL 723 and ASTM-E84 flame spread and smoke developed requirements of 25/50 and shall comply with NFPA 90A and the latest edition of the NC Building Code. Insulation shall be Certainteed, Owen Corning, Knauf, or Johns-Manville.
- B. All air conditioning supply, return, relief, and outside air ducts concealed above a ceiling and the back of all diffusers and grilles shall be externally insulated with 2" thick 1 lb. density foil scrim kraft jacketed insulation. Adhere insulation to duct with fire retardant adhesive in sufficient quantities to prevent sagging. Ducts with a width over 30" shall be further secured on all sides with mechanical fasteners on 18" maximum centers. Insulation shall be butted with facing overlapping all joints at least 2" and sealed with fire retardant vapor barrier adhesive. Tape all joints, breaks, punctures, and any penetrations with SMACNA foil faced kraft duct tape.
- C. All air conditioning supply, return, relief, and outside air ducts exposed in mechanical equipment rooms, in finished areas, and where indicated for sound attenuation shall be externally insulated. Insulation shall be 2" thick 3.0 lb. density board insulation with FRK facing. All joints shall be taped per manufacturer's recommendations. Insulation shall be completely secured to ductwork with pins and washers on all surfaces and sides.
- D. Refrigerant piping shall be insulated with tubular closed cell elastomeric insulation with all joints butted and cemented tight. Insulation shall be 1-1/2" thick. Entire length of gas line shall be insulated. Liquid line shall be insulated where outside the thermal envelope or on exterior of the building. Insulation on refrigerant piping exposed on the building's exterior shall have aluminum jacket as hereinafter specified.
- E. Air handling unit drain pan condensate piping on interior and pumped condensate piping shall be insulated with tubular closed cell elastomeric insulation with all joints butted and cemented tight. Insulation on interior condensate piping shall be 1" thick.
- F. Exposed exterior piping insulation above grade shall be provided with a protective aluminum jacket with a factory-applied poly backing moisture barrier. Aluminum jackets shall be cross-crimped (longitudinally corrugated) for strength. Aluminum jackets shall be not less than 0.016" thick and shall be secured with aluminum or stainless steel screw; not more than 8" apart. Each jacket shall be applied by turning a 1" hem inward on one longitudinal edge and then lapping the hemmed edge over the unhemmed edge. The jacket may be machine cut to produce a straight smooth edge and the hem omitted. The longitudinal and circumferential seams shall be lapped not less than 2". Jackets on horizontal lines shall be so installed that the longitudinal seams are on the bottom half of the pipe with the seam of each jacket slightly offset from the seam of the adjacent jackets; top edge shall overlap bottom edge. The jackets on vertical lines and lines pitched from the horizontal shall be installed from low point to high point so that the lower circumferential edge of each jacket overlaps the jacket below it. Special fitting jackets conforming to the above with the exception of longitudinal lapping dimensions and location of seams shall be used for fittings, valves, and flanges. Jackets for fittings, valves, and flanges shall be properly overlapped and secured. Equivalent aluminum jacketing system, when approved, will be acceptable.

230520 SPECIALTIES

- A. Floor, wall and ceiling plates or escutcheons of size to fit pipe covering shall be installed where pipes pass thru finished areas and shall be chromium plated spring type as manufactured by Kenney, Connecticut Stamping and Bending Company, Dearborne or approved equal.
- B. Unions or flanges shall be provided throughout the piping system to facilitate the removal and servicing of all valves, equipment, items, etc.

230521 FOUNDATIONS

- A. All concrete and reinforcing steel for foundation slabs under equipment shall be provided by the Heating and Air Conditioning Contractor. Foundations shall extend beyond all equipment by 4" in all directions and shall be made from 3,500 PSI concrete reinforced with 10/10 x 6/6 wire mesh. Foundation surfaces shall be troweled smooth and edges shall be tooled. Equipment pads shall be painted OSHA approved yellow.

230522 VIBRATION ISOLATION

- A. Pad type isolators shall be 3/4" thick bridge bearing quality neoprene ribbed or waffled on both sides. Pads shall be selected for a maximum durometer of 50 and designed for 15% deflection. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.
- B. Flexible duct connections, both at inlet and discharge of units, shall be made of 30 oz. workinglass fiber coated with neoprene, sewn together at edges and joints. These flexible connections shall withstand the operating air-pressure, shall not permit air leakage, and shall not transmit vibration.

230523 OPENINGS

- A. The Heating and Air Conditioning Contractor shall furnish all blockouts, sleeves, and openings required for his work. Pipe sleeves, where firestop penetration system allows, shall be standard weight black steel pipe and shall be provided where pipes pass through walls and floor. Sleeves through walls shall butt flush with the wall finish and shall be of sufficient size to permit passage of pipe covering through the area where pipe is installed. Sleeves through floors shall extend 3/4" above the finished floor and sealed watertight. Any penetrations of ducts through floor shall be curbed 3" high x 6" wide with concrete. Specifically inform as to the correct size and location of openings and sleeves to insure that they shall be cast in their proper location. Sleeves and duct opening frames shall be furnished and installed by the Heating and Air Conditioning Contractor. Failure to indicate such openings in time to avoid delaying the project shall result in the Heating and Air Conditioning Contractor providing all cutting and repairing at his own expense. Repairing shall include sealing tight around pipe sleeves and duct frames in a neat and professional manner and in accordance with the "Cutting and Patching" section of this specification.
- B. All penetrations in rated floors, firewalls and any other rated separations shall be protected using a through-penetration firestopping method with an "F" rating equivalent to the rating of the membrane being penetrated for particular piping materials used and membrane construction type. Floor penetrations shall additionally have a "T" rating equivalent to the rating of the floor being penetrated. Through-penetration firestop systems shall be installed and tested in accordance with ASTM E814 or UL 1479.
- C. Any through-penetration firestop details indicated on the drawings are suggestive only. Heating and Air Conditioning Contractor shall submit for approval specific through-penetration firestop system details to be used.

230524 COLOR CODING/PAINTING

- A. All exposed mechanical equipment in finished areas including ductwork, piping hangers, etc., shall be painted the same color as the adjacent ceiling and walls. Heating and Air Conditioning Contractor shall treat all items as necessary to receive paint.

230525 PIPE MARKERS

- A. Markers shall have wording, wording colors, and wording background in accordance with ANSI A13.1. Markers shall have letters approximately 1" high on appropriate background, flow arrows, and shall be located on the pipe at intervals not exceeding 10'-0" where in mechanical spaces and 25'-0" intervals where

above ceilings. Markers shall be plastic with markers on piping completely encircling the pipe with overlap and permanent tension in the marker to grip the pipe firmly with the need of adhesives. Provide markers on all new or renovated piping in the building. Wording of markers shall be as follows:

1. Refrigerant.
2. Condensate.
3. Pumped Condensate.

#### 230526 NAMEPLATES

- A. All new and existing packaged units, split systems, heaters, and power ventilators shall be furnished with engraved plastic laminated labels permanently attached to the equipment. Lettering shall be ½" tall. Label shall include equipment number, area served, substantial completion date, number and size of filters, number and size of belts, and capacities. Substantial completion date shall be on a separate label so as to allow equipment nameplates to be installed prior to final acceptance.
- B. Provide engraved plastic laminated or plastic tape label on ceiling grid below new power ventilators located above ceilings. Label text shall match the piece of equipment's identifier/symbol noted on the drawings.

#### 230527 EXCAVATION, TRENCHING AND BACKFILL

- A. The Heating and Air Conditioning Contractor shall perform all excavation and backfilling required for the installation of this work or whatever substance encountered, to the depths indicated and required in accordance with this section and Division 31 of these specifications. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from banks to avoid overloading and to prevent cave-ins. Provide adequate support of sidewalls for protection of the work and personnel and as required by regulation of the NC State Dept. of Labor and US Department of Labor, Occupational Safety and Health Administration, Occupational and Safety and Health Standards.
- B. Extreme caution shall be exercised in advance to avoid damage to existing utilities and structures. All existing utilities and structures shall be protected from damage and, if damaged, shall be repaired by the Heating and Air Conditioning Contractor at his own expense. Should utility lines be encountered within the area of operations, the Heating and Air Conditioning Contractor shall notify the Architect in ample time for necessary measures to be taken to prevent interruption of service.

#### 230528 CUTTING AND PATCHING

- A. The Heating and Air Conditioning Contractor shall do all cutting and patching necessary to install all equipment as required under his contract in accordance with the General Conditions of these specifications and shall re-establish all finishes where cutting and patching occur to their original condition. All cutting of the structure, where unavoidable, must be approved by the Engineer and be done by not the Heating and Air Conditioning Contractor, but shall be paid for by the Heating and Air Conditioning Contractor.

#### 230529 PIPING PRESSURE TESTING

- A. The Heating and Air Conditioning Contractor shall make the following tests before the systems are insulated or covered by construction. The systems shall have no decrease in pressure during the test periods. All system components shall be protected from test pressures that exceed manufacturer's design limits.
- B. Notify Architect and Engineer 48 hours in advance of all tests.
- C. Heating and Air Conditioning Contractor shall provide written report of each test.

- D. New or renovated refrigerant piping shall be tested in accordance with Chapter 11 of the North Carolina Mechanical Code and split system unit manufacturer's recommendations.
- E. New condensate piping shall be tested by applying a hydrostatic pressure of 100-psig for a period of two hours.
- F. No caulking of joints shall be permitted. Any joint found to leak under this test shall be broken, remade, and a new test applied. Welded joint pinhole leaks shall be repaired by welding; however, welds that show numerous pinholes shall be replaced.

#### 230530 TESTING AND BALANCING

- A. Testing and balancing of the existing, new, or renovated heating, ventilating, and air conditioning systems shall be performed by an AABC certified Test and Balance Company as a subcontractor to the Heating and Air Conditioning Contractor. All instruments used shall be accurately calibrated and in good working order. The tests shall be in strict accordance to the Standards of AABC. Test and Balance Contractor shall submit TAB plan to the Engineer and Commissioning Authority for their review and approval prior to starting any TAB work.
- B. Air balance and testing shall not begin until the systems have been installed in full working order and shown to be operating satisfactory on both heating and cooling. The Contractor shall place all heating, ventilating, and air conditioning systems into full operation and shall continue operation of the system until balancing is completed. All operational cost shall be borne by the Heating and Air Conditioning Contractor. The Architect and Engineer shall be given two weeks advance notice of when tests are to be made.
- C. Upon completion of the heating, ventilating, and air conditioning systems, the Test and Balance Contractor shall compile the test data and submit four copies of the completed test data to the Engineer for evaluation and approval. At final inspection and prior to final commissioning verification, Heating and Air Conditioning Contractor shall have a copy of test and balance report and all necessary personnel and equipment to facilitate spot-checking of test and balance data by the Engineer or his representative. Final payment to the Contractor shall be withheld until the complete test and balance data has been approved.
- D. Testing Procedure (AIR):
  - 1. Test and adjust air handling unit fan's RPM and CFM to design requirements. Record all data.
  - 2. Test and record motor full load amperes on all motors. Record all data.
  - 3. Check and record coil leaving air temperatures from coils when in full cooling, full heating, and from full hot gas reheat coil.
  - 4. Adjust all main supply, exhaust, return, relief, and outside air ducts to proper design CFM when air handling systems are in normal operating mode and in outside air economizer mode. Record supply, return, exhaust, relief, and outside air data.
  - 5. Test and adjust each diffuser, grille, and register for supply, exhaust, and return systems to within 10% of design requirements. Record all data.
  - 6. All adjustments to air diffusing devices where possible shall be made in trunk or run out dampers, not at diffuser volume control.
  - 7. Exhaust fans shall be tested and balanced for the requirement as shown on the plans. Record all data.
  - 8. The Heating and Air Conditioning Contractor shall make any changes in the pulleys, belts, filters, dampers, or valves necessary or as recommended by the Engineer for correct balance at no additional cost to the Owner.

#### 230531 INSTRUCTIONS/TRAINING

- A. The Heating and Air Conditioning Contractor shall give an instruction and training period in the operation of the apparatus to the persons who will be in charge of the system. See Section 017900 for listing and training requirements.

230532 MAINTENANCE DATA

- A. For all new or renovated items requiring maintenance, the Heating and Air Conditioning Contractor shall furnish two weeks prior to Final Acceptance and deliver to the Owner's representative on the job multiple copies of complete data as prepared by the manufacturer covering the details of operation and maintenance and complete parts list for all equipment specified. Each copy of the maintenance data shall be assembled into a 3-ring hardback binder with indexing and label on cover and spine. Data shall include:
1. Index with page numbers.
  2. List of all subcontractors and suppliers with names, addresses, and phone numbers.
  3. Contractor's certificate of Final Acceptance.
  4. Copy of all warranties.
  5. Equipment model numbers, etc. indicated and referenced with the same mark as shown on equipment on the drawings.
  6. Filter schedules of sizes and quantities for all equipment requiring filters referenced by mark on the drawings.
  7. Equipment summary showing all capacities and ratings.
  8. Certified test and balance report.
  9. Start-up and test reports for equipment.
  10. Complete start-up, operation, and shut-down procedures for each system.
  11. Lubrication schedules and types of lubricates.
  12. All submittal data and shop drawings, unless included in a separate manual.
  13. See Section 017823 for additional requirements.

230533 RECORD DRAWINGS

- A. In accordance with Section 017839 Project Record documents, the Heating and Air Conditioning Contractor shall maintain "during the course of the work" a set of specifications and drawings marked up to show the new and renovated work as installed, **including a minimum of two dimensions to indicate locations and elevations of buried work**. Upon completion of the work, return this set of drawings to the Architect.

230534 GUARANTEE

- A. The Heating and Air Conditioning Contractor shall guarantee the entire new and renovated portions of the heating and air conditioning system subject to the General Conditions of these specifications, except:
1. Refrigeration compressors for packaged gas heating electric cooling units, split system heat pump units, and ductless split system heat pump units shall have a four-year extended warranty for the compressors only. Refrigerant, labor, freight, and other required parts shall be provided or paid for by the Owner.
  2. Heating section heat exchanger for packaged gas heating electric cooling units shall have factory 10-year warranty.

END OF SECTION 230500



## SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

### 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 DESCRIPTION OF WORK

- A. Furnish and install an electric control system to fulfill the intent of the drawings and specifications. The systems shall include all necessary labor, electrical wiring, controllers, programmable thermostats, devices, and materials for a complete installed control system. The control system shall be erected, assembled, and installed by factory-trained mechanics regularly employed by the control manufacturer or manufacturer's authorized distributor as a subcontractor to the Heating and Air Conditioning Contractor. All equipment, unless specified to the contrary, shall be fully proportional and shall be the product of the control manufacturer.
- B. The control diagrams indicated on the drawings or specified herein show the intended sequences of operation of the various control systems and shall be followed as closely as practicable. All required devices and control schemes may not be shown on the drawings. It is the Contractor's responsibility to provide all devices and control schemes whether shown or not.
- C. Additional General Requirements for Controls:
  - 1. All wiring, conduit, and panels for all temperature controls.
  - 2. Power required for controls shall be provided by the Controls Contractor from points coordinated with the Electrical Contractor.
  - 3. Perform all wiring in accordance with all local and national codes and Division 26 of these specifications.
  - 4. Surge transient protection shall be incorporated in the design of the system to protect electrical components in all system components as described below under "General Product Description."
  - 5. System modifications necessary to fine-tune sequences during commissioning of systems at no additional cost to the Owner.
  - 6. Mount control devices inside of a UL-listed steel enclosure panel, with hinged locking cover and key locking latch.
- D. Wiring and Controls:
  - 1. Control Contractor shall be responsible for the installation and wiring of temperature controls, control interlock wiring, electrical controls and devices in the temperature control system.

#### 1.3 QUALITY ASSURANCE AND STANDARDS

- A. Materials and equipment shall be the cataloged products of manufacturers regularly engaged in production and installation of integrated control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- B. All products used in this project installation shall be new and currently being manufactured. This installation shall not be used as a test site for any new products. Spare parts shall be available for at least five years after completion of this contract.

- C. Install system using competent workmen who are fully trained in the installation of integrated control systems.
- D. Single source responsibility of Contractor shall be the complete installation and proper operation of the control system and shall include debugging and proper calibration of each component in the entire system.
- E. Contractor shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.
- F. The Contractor and manufacturer representative shall support the installed system for a minimum of 1 year. The support shall provide full material warranty of controllers and 8 hours of on-site training.
- G. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, governing Radio Frequency Electromagnetic Interference and be so labeled.
- H. Design and build all system components to be fault-tolerant.
  - 1. Satisfactory operation without damage at 110% and 85% of rated voltage and at plus 3-Hertz variation in line frequency.
  - 2. Static, transient and short-circuit protection on all inputs and outputs.
  - 3. Protect communication lines against incorrect wiring, static transients and induced magnetic interference.
  - 4. Network-connected devices to be A.C. coupled or equivalent or that any single device failure will not disrupt or halt network communication.
  - 5. All real time clocks and data file RAM to be battery-backed for a minimum 72 hours and include local and system low battery indication.
  - 6. All programs shall retain their memory for a minimum of 7 days upon loss of power.
- I. Comply with NFPA 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
- J. Provide wiring in accordance with NEC requirements and Division 26 of these Specifications.

#### 1.4 SUBMITTALS

- A. Product Data: Submit copies of manufacturer's technical product data for each control device furnished. Indicate dimensions, capacities, performance, electrical characteristics, material finishes; also include installation and start-up instructions.
- B. Shop Drawings: Submit copies of shop drawings for each control system, containing at least the following information:
  - 1. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves, control devices and all interconnections between devices.
  - 2. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  - 3. Written description of sequence of operation.
- C. Number of copies of Product Data and Shop Drawings shall be per Division 1 of these Specifications.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Provide equipment and control devices in factory shipping carton. Maintain in cartons while shipping, storing and handling as required to prevent equipment damage and to keep dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS

- A. Building controls, controllers, and communications between devices shall be provided as necessary to achieve specified sequences of operation.
- B. Room heating and cooling thermostats shall be programmable, low voltage, automatic changeover, dual setpoint type with non-volatile memory, key pad lockout, temporary program override, temperature warmer/cooler adjustment, and night temperature setback control. Thermostat shall have heat anticipation, fan on-off switch, multi-stage cooling control and multi-stage heating control to match units controlled, and all capabilities to satisfy the sequences of operation as specified.
- C. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degree F. Sensors shall be selected for wall, duct or outdoor type installation as indicated. Duct mounted sensors shall have LCD display.
- D. Motorized control dampers that are not integral to the equipment shall be furnished by the Control System Contractor. See Section 230500 for specification of motorized control dampers.
- E. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators.
- F. Duct-Mounted Temperature Sensors: 20,000-ohm thermistor temperature sensors with an accuracy of  $\pm 0.2^{\circ}\text{C}$ . Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -40 to 160 degrees F. The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air and preheat air applications, install bendable averaging duct sensors with a minimum 8 - foot long sensor element. These devices shall have accuracy of 0.5 degrees, F., over the entire range.
- G. Current Sensitive Switches: Solid state, adjustable, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point. Manufacturer: Veris, or approved equivalent.
- H. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a subbase and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.
- I. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120VAC/24VAC operation.
- J. Line voltage protection: All control system panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the

manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION - GENERAL

- A. Install systems and materials in accordance with manufacturer's instructions in a neat workmanlike manner.
- B. Coordinate with other trades on the project as the work progresses so that each will be aware of the extent of all work. Carefully plan all work and check for interferences before installation. No extras will be allowed for changes caused by failure to check for interferences.
- C. Provide structural supports as required for panels and control devices.
- D. Supervise installation of all control dampers.
- E. Install metering devices away from bends and elbows with minimum upstream and downstream straight distances per manufacturer's recommendations and as shown on Drawings.

#### 3.2 CONTROL WIRING

- A. Install color-coded control wiring without splices between terminal points in accordance with National Electrical Code.
- B. Install circuits over 25 volts with color-coded No. 12 or 14.
- C. Install circuits under 25 volts with color-coded cable as recommended and approved by the manufacturer.
- D. Wiring and cable used does not have to be plenum rated.
- E. Wiring above lay-in ceilings may be installed as properly supported cable.
- F. Wiring above hard ceilings, in walls, or where exposed including in mechanical rooms shall be in 3/4" minimum EMT conduit with steel-plated hexagonal compression connectors. Flexible metallic conduit shall be 1/2" minimum in size and not exceed 3'-0" in length. Control conduit shall be blue in color.
- G. All wiring in floor slabs or on exterior shall be run in rigid conduit.
- H. All junction boxes for controls shall have blue covered and be labeled.

#### 3.3 TESTING

- A. When installation of the control system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line.
- B. Provide a cross check of each control point within the control system by making a comparison between the control command and the field-controlled device.
- C. Replace any work found defective. After replacement, repeat test.

### 3.4 START-UP AND DEMONSTRATION

- A. After completion and testing of the installation, regulate, adjust and service as necessary all control devices in the systems, placing each item in complete and proper operation.
- B. Demonstrate all systems to Owner, Architect and Engineer, and that all are operable from local controls in the specified failure mode upon electronic control system failure or loss of power.
- C. Complete all commissioning requirements as necessary to this scope of work.

### 3.5 INSTRUCTION

- A. Provide the services of manufacturer's technical personnel for 8 hours of instruction to Owner's personnel in the operation, maintenance and programming of the control system. Orient the training specifically to the system installed rather than a general training course.
- B. Provide training manuals, equipment and material required for classroom training.
- C. Training to include the following items:
  - 1. Operation of equipment
  - 2. Programming
  - 3. Diagnostics
  - 4. Failure recovery procedures
  - 5. Alarm formats (where applicable)
  - 6. Maintenance and calibration
  - 7. Trouble shooting, diagnostics, and repair instructions

## PART 4 - POINTS LISTS AND SEQUENCES OF OPERATION

### 4.1 SUMMARY

- A. The drawings indicate the individual types of systems and the points required in each system.
- B. System sequences of operation shall be as indicated on the drawings and as specified herein.

END OF SECTION 230900

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## SECTION 260000 – ELECTRICAL, BASICS

### 1.1 RELATED DOCUMENTS

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

### 1.2 GENERAL

- A. Applicable requirements of any Instructions to Bidders, General Conditions of the Contract, and/or Supplemental Conditions shall be a part of the Electrical Specifications. The electrical contractor shall examine all contract documents before submitting a proposal.
- B. The electrical work shall be performed by an electrical contractor, suitably licensed for the scope of work of this specific project.
- C. The electrical contractor shall assume total responsibility for any portion of the work provided by his subcontractors.

### 1.3 CODES AND STANDARDS

- A. Building Codes:
  - 1. National Fire Protection Association No. 70, National Electrical Code (NEC)
  - 2. National Fire Protection Association No. 72, National Fire Alarm and Signaling Code
  - 3. North Carolina State Building Code, Latest Edition and Revisions (NCSBC)
  - 4. North Carolina State Fire Code, Latest Edition and Revisions
  - 5. National Electrical Safety Code (NESC)
  - 6. National Bureau of Standards (NBS)
  - 7. Local Codes where applicable
- B. Industry Standards:
  - 1. Underwriter's Laboratories, Inc. Standards and approved listings (UL)
  - 2. Electrical Testing Laboratories Standards (ETL)
  - 3. National Electrical Manufacturers Association Standards (NEMA)
  - 4. Insulated Power Cable Engineers Association Standards (IPCEA)
  - 5. American National Standards Institute (ANSI)
  - 6. American Society for Testing Materials Standards (ASTM)
  - 7. Canadian Standards Association (CSA)

### 1.4 QUALITY ASSURANCE

- A. Electrical materials, equipment, devices, fixtures, etc. shall be listed and labeled by a third-party agency that is accredited by the NCBCC (North Carolina Building Code Council) to label electrical & mechanical equipment. Listing and labeling shall comply with NC Department of Insurance requirements as detailed in NC General Statutes 66-23 through 66-25. This paragraph applies to all electrical specification sections under specification divisions 26, 27, and 28.

### 1.5 SCOPE OF WORK

- A. It is the intent and meaning of the drawings and specifications to call for finished work that has been tested and is ready for operation. The electrical contractor shall take this into consideration and include

in his proposal allowance for contingencies that will allow him to provide minor pieces of materials and labor not specifically indicated but required for the job to operate properly. This paragraph is intended to insure that a complete job will be provided without requests for minor extras.

- B. It shall be understood that where the words “furnish,” “provide,” and/or “install” are used, it is intended that this CONTRACTOR shall purchase and install completely all material necessary and required for this particular item, system, equipment, etc.

#### 1.6 ELECTRICAL SERVICE

- A. The electrical contractor shall be totally responsible for coordination with the Utility Company and assistance to the OWNER to obtain a permanent electrical service for the structure. He shall act as coordinator between the Utility Company and the OWNER and shall supply the Utility Company with equipment characteristics, load data, etc. Any installation, connection, underground service or special fees charged by the Utility Company for the new service shall be paid by the OWNER. Construction and testing power shall be paid for as described in the General Conditions of the project manual.
- B. Electrical service to the structure shall be 120/240 volts, single phase, 3 wire.
- C. The electrical contractor shall coordinate the electrical service, metering and metering equipment with the local utility company for arrangements, locations, connections, etc.
- D. Utility transformer pads shall be installed by the electrical contractor. Coordinate equipment pad requirements with the local utility company.
- E. Current transformer cabinets and self-contained meter cabinets shall be installed by the electrical contractor, unless directed otherwise by the Utility Company. Coordinate metering requirements with the Utility Company before rough-in of service raceways.
- F. The electrical service entrance raceways shall be installed by the electrical contractor and sized as shown on the contract drawings, or as required by the Utility Company. Service entrance conductors will be provided and installed by the Utility Company to the line side of the metering equipment. Service entrance conductors from the metering equipment to the service equipment shall be provided by the electrical contractor. Load side connections shall be made by the electrical contractor.

#### 1.7 RECORD DRAWINGS

- A. A set of drawings covering the electrical contract will be provided to the electrical contractor to mark in color all changes, modifications, or revisions effected during construction. These field mark-up drawings are to be turned over to the electrical designer.
- B. The electrical contractor shall provide final installed photographs of switchboards and panelboards. Photographs shall clearly show equipment designations, manufacturer nameplates, breaker positions, breaker ratings, and directory descriptions.

#### 1.8 APPROVAL OF MATERIALS

- A. See project manual contract documents for pre-proposal substitution requirements.
- B. Construction phase: The CONTRACTOR shall submit his proposal on the specified materials and equipment, or their equivalent, provided the words "or equal" or "or approved equal" follow the named manufacturers. If the above phrases do not appear, the specified manufacturers shall be furnished without substitution. Equivalent shall be interpreted to mean an item of material or equipment, similar to that



named and which is suitable for the same use and capable of performing the same functions as that named, with the Design Team being the judge of equality.

- C. Where no specific material or equipment type is mentioned, any first-class product of a reputable manufacturer may be used provided it conforms to the requirements of the specifications.

#### 1.9 SHOP DRAWINGS AND SUBMITTAL DATA PROCEDURES

- A. The CONTRACTOR shall submit PDF files of shop drawings, certified prints, literature, and product data sheets to the Design Team for all major items of equipment and materials for review and approval. It is preferred that all electrical submittals for the project shall be submitted at one and the same time.
- B. Product data sheets with multiple components, part numbers, etc. shall be clearly marked or highlighted to identify what specific product/model/part number/component is proposed for this project. All instances of the proposed part number components in the product data shall be marked or highlighted throughout product data sheets submitted.
- C. The CONTRACTOR shall analyze all shop drawings and submittal data and certify that they meet requirements of Contract Drawings and Specifications, prior to delivery to the Design Team. CONTRACTOR Certification shall be in the form of suitable approval stamp placed on each shop drawing/submittal submitted.
  - 1. If the shop drawings or submittal data deviate from the Contract Documents, the CONTRACTOR shall advise the Design Team of deviations in writing, accompanying the shop drawings and submittal data, including the reason for deviations.
- D. If the Design Team deems submittal data is either incomplete or incorrect, a resubmittal will be required. Where a resubmittal is not necessary but confirmation of receipt of review comments is requested, confirmation shall be submitted in writing.
- E. At least one set of all final submittal data, shop drawings, certified prints, etc., shall be maintained at the job site and available to representatives of the Design Team.
- F. Approval by the Design Team of shop drawings and submittal data is for general conformance with the contract documents and design concept.
  - 1. Such approval does not relieve the CONTRACTOR of responsibility for compliance with the project drawings and specifications.
  - 2. Such approval for any materials, apparatus, devices, and layouts shall not relieve the CONTRACTOR from the responsibility of furnishing same of proper dimensions, size, quantity, quality and all performance characteristics to efficiently complete the requirements and intent of the contract documents.
  - 3. Such approval shall not relieve the CONTRACTOR from responsibility for errors of any sort on the shop drawings.
- G. Physical sizes of equipment used in the design layout are those of reputable equipment manufacturers. The CONTRACTOR is responsible for providing equipment that will fit the space available. If the CONTRACTOR elects to use equipment that results in conflicts with space clearance or codes, it shall be the responsibility of the CONTRACTOR to correct at his expense. The CONTRACTOR shall be responsible for providing code clearances. Where equipment is designated for existing space, the CONTRACTOR shall make necessary field measurements to ascertain space requirements, including those for connections; and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the intent and meaning of the drawings and specifications.

H. Catalog Data for OWNER:

1. The CONTRACTOR shall provide compilations of catalog data, bound in suitable loose-leaf binders, for each manufactured item of equipment used in the electrical work. These shall be presented to the Design Team for transmittal to the OWNER before the final inspection is made. Data shall include printed installation, operation, and maintenance instructions for each item, indexed by product with heavy sheet dividers and tabs. All warranties shall be included with each item. Each manufacturer's name, address, and telephone number shall be clearly indicated. Generally, shop drawings and submittal data alone are not adequate for catalog data.

I. Record Documents for OWNER:

1. Conductor and cable megger test results.
2. Field mark-up as-built drawings.
3. Grounding electrode system test results.
4. Fire alarm system:
  - a. NFPA 72 Fire Alarm System Record of Completion.
  - b. System Status and Programming Report.
  - c. System operational matrix.
  - d. Digital copy of system software on USB flash drive.
2. Emergency responder radio coverage system:
  - a. Documentation of system acceptance by the local Fire Marshal / AHJ.
  - b. RF Survey / Shop Drawings: Final installed measurement drawings of each floor of the building which indicate relative RF field strength for each frequency and band of interest.
3. Warranty documents.

1.10 DRAWINGS AND SPECIFICATIONS

- A. The Electrical drawings and specifications are complementary each to the other, and what may be called for by one shall be as binding as if called for by both. The drawings are diagrammatic and indicate generally the location of outlets, devices, equipment wiring, etc and show the general arrangement of raceways, fixtures, and equipment. Drawings shall be followed as closely as actual building construction and the work of other trades will permit; however, all work shall suit the finished surroundings and/or trim.
- B. Any omission from either the drawings or the specifications are unintentional, and it shall be the responsibility of the CONTRACTOR to call to the attention of the Design Team any pertinent omissions before submitting a proposal. Complete and working systems are required, whether every small item of material is shown and specified or not.
- C. The electrical work shall conform to the requirements shown on all of the drawings. General and Structural drawings shall take precedence over Electrical Drawings. Because of small scale of the electrical drawings, it is not practical to indicate offsets, fittings and accessories that may be required. The CONTRACTOR shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings and accessories as may be required to meet such conditions, without additional cost to the OWNER and as directed by the Design Team.
- D. Load circuits shall be installed as indicated on the drawings. Circuit number revisions will not be accepted unless approved in writing by the Engineer.

## 1.11 COORDINATION OF WORK

- A. It is understood and agreed that by submitting a proposal, the CONTRACTOR has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality and quantity of the materials to be encountered, the general and local conditions and all other matters which can and may affect the work under this contract. The CONTRACTOR shall be held responsible for visiting the site and thoroughly familiarizing himself with the existing conditions and also any contractual requirements as may be set forth in other divisions of the specifications and in other contract documents. No extras will be considered because of additional work necessitated by obvious job conditions that are not indicated on the drawings.
- B. The CONTRACTOR shall compare the electrical drawings and specifications with the drawings and specifications for other trades and shall report any discrepancies between them to the Design Team. If needed, request from the Design Team written instructions for changes necessary in the electrical work. The electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the CONTRACTOR shall make proper provisions to avoid interferences in a manner approved by the Design Team. All changes required in the work of the CONTRACTOR caused by his neglect to do so shall be made by him at his expense.
- C. Location of electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The CONTRACTOR shall determine the exact route and location of each electrical raceway prior to make up and assembly.
- D. Right-of-Way: Lines which pitch shall have the right-of-way over those which do not pitch. For example; steam, condensate and plumbing drains shall normally have right of way. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed.
- E. Offsets and changes in direction of electrical raceways shall be made as required to maintain proper headroom and to clear pitched lines whether or not indicated on the drawings. The CONTRACTOR shall furnish and install elbows, pull boxes, etc., as required to affect these offsets, transitions, and changes in directions. Conflicts between electrical raceways, fixtures, etc., and ductwork which cannot be resolved otherwise, will be resolved by the Design Team.
- F. The CONTRACTOR shall install all electrical work to permit removal (without damage to other parts) of any equipment requiring periodic replacement or maintenance. The CONTRACTOR shall arrange electrical raceways and equipment to permit ready access to valves, cocks, traps, starters, motors, control components, etc., and to clear the opening of swinging and overhead doors and of access panels.
- G. Equipment and Materials (General):
  - 1. Materials shall be new and shall bear the manufacturer's name, trade name, and listing label in every case where a standard has been established for the particular material. The equipment to be furnished under this specification shall be essentially the standard product of manufacturers regularly engaged in the production of the required type of equipment and shall be the manufacturer's latest approved design.
  - 2. Electrical motors shall meet the minimum efficiency requirements identified in the Code of Federal Regulations 10 CFR Part 431.
  - 3. Delivery and Storage:
    - a. Store products to allow for inspection and measurement of quantity or counting of units.
    - b. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
      - 1) Electrical equipment shall be delivered to the site and stored in original containers. Store protected from the elements, but readily accessible for inspection by the Design Team until installed. Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury and theft. Corrosion

inhibitors shall be installed in all panelboards, switches, starters and control panels immediately upon receipt. Install one inhibitor for every 8 cubic feet of enclosure volume. Replace inhibitors every 90 days and at final inspection in the Design Team's presence. Rusty and/or corroded materials and equipment will be replaced at the direction of the Design Team.

- 2) Rusty and/or corroded materials and equipment will be replaced at the direction of the Design Team.
- c. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
- d. Protect stored products from damage.
4. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.
5. At the completion of work; fixtures, equipment, and materials shall be cleaned and polished thoroughly and turned over to the OWNER in a condition satisfactory to the Design Team. Damage or defects, developing before acceptance of the work shall be corrected at the CONTRACTOR's expense.
6. Manufacturer's directions shall be followed completely in the delivery, storage, protection, and installation of all equipment and materials. The CONTRACTOR shall promptly notify the Design Team, in writing, of any conflicts between requirements of the Contract Documents and the manufacturer's directions and shall obtain the Design Team's written instructions before proceeding with the work. Should the CONTRACTOR perform any work that does not comply with the manufacturer's instructions, recommendations, or requirements; it shall be corrected at his expense as directed by the Design Team.

H. Sleeves, Inserts, Openings, Etc.:

1. Anchor bolts, sleeves, inserts, supports, etc., that may be required for electrical work shall be furnished, located, and installed by the electrical contractor. Where working under a subcontract for a General Contractor, the electrical contractor shall give sufficient information (marked and located) to the General Contractor in time for proper placement in the construction schedule. Should the electrical contractor delay or fail to provide sufficient information in time, the electrical contractor shall cut and patch construction as necessary and required to install electrical work, with finishes completed to the satisfaction of the Owner and the Design Team.

I. Cutting and Patching:

1. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces required to permit electrical installations. The electrical contractor shall be responsible for cutting and patching as required for the proper installation of electrical work for this project. Cutting shall be kept to a minimum. Repair and refinish disturbed finish materials and other surfaces to match adjacent undisturbed surfaces. Install new fireproofing where existing firestopping has been disturbed. Finishes shall be restored to the satisfaction of the Owner and the Design Team.

J. Locations and Measurements:

1. Outlets, equipment, fixtures, etc. are shown and located on the drawings as intended based on the Design Team's understood project scope. All measurements for installation shall be verified on the project and coordinated with the drawings of other disciplines. In all cases, work shall suit the surrounding trim and/or decoration and construction. The locations of outlets for appliances shall be installed so that when connected they permit the proper installation of appliances. Slight relocations of outlets, devices, and equipment shall be made by the electrical contractor as required or as directed by the Design Team at no additional cost to the OWNER.

K. Workmanship:

1. Work shall be executed as required by the drawings and specifications, shall be done in a workmanlike manner by skilled mechanics, and shall present a neat, trim, and mechanical appearance when completed. All work shall be performed as required by the progress of the job.

L. Final Inspections and Equipment Demonstrations:

1. The CONTRACTOR shall acquire permits for construction & coordinate all required inspections with the office of the local electrical inspector and/or local authority having jurisdiction, if required. The CONTRACTOR shall provide the Owner two (2) copies of Electrical Inspectors' written reports.
2. The CONTRACTOR shall furnish ladders, required tools, and personnel to open equipment, fixtures, boxes, panels, etc. to enable the Design Team representatives to observe any parts of the installation they may request.
3. The CONTRACTOR shall furnish meters for observation of readings as directed by the Design Team representative. Meters to be furnished include: clamp-on type ammeter, voltmeter, insulation resistance tester (i.e., often called a megger), and clamp-on type ground resistance tester.

M. Operating Instructions:

1. At the completion of the entire installation, the CONTRACTOR shall arrange to operate each component of systems and then systems as a whole. When all the requirements of the plans and specifications have been met, the CONTRACTOR shall then arrange to instruct the OWNER's operating and maintenance personnel in the correct and proper procedures for the operation and maintenance of the systems

END OF SECTION 260000

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## SECTION 260500 - BASIC ELECTRICAL MATERIALS AND METHODS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Supporting devices for electrical components.
  - 2. Cutting and patching for electrical construction.
  - 3. Touchup painting.
  - 4. Firestopping
  - 5. Concrete equipment bases.
  - 6. Electricity-metering components.

#### 1.3 SUBMITTALS

- A. Product Data:
  - 1. Support channels and hardware.
- B. For materials to firestop cable and raceway penetrations of fire-rated floor and wall assemblies.
- C. Shop Drawings:
  - 1. UL details for firestopping cable and raceway penetrations of fire-rated floor and wall assemblies.

#### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.

### PART 2 - PRODUCTS

#### 2.1 SUPPORTING DEVICES

- A. Metal Items for Use Indoors: Plain Steel.
- B. Metal Items for Use Outdoors or in Damp Locations: Hot-dip galvanized steel.
- C. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
- D. Slotted Support Systems Fittings and Accessories: Products of the same manufacturer as channels.
- E. Raceway and Cable Supports: Manufactured clevis hangers, riser clamps, straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring-steel clamps or click-type hangers.

F. Expansion Anchors:

1. Inside: Carbon-steel wedge or sleeve type.
2. Outside: Hot-dip galvanized steel wedge or sleeve type.

G. Toggle Bolts:

1. Inside: All steel springhead type.
2. Outside: Hot-dip galvanized steel springhead type..

2.2 TOUCHUP PAINT

- A. For Equipment: Equipment manufacturer's paint selected to match installed equipment finish.
- B. Galvanized Surfaces: Zinc-rich paint recommended by item manufacturer.

2.3 FIRESTOPPING

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

2.4 CONCRETE BASES

- A. Concrete: Unless detailed otherwise; 3000-psi, 28-day compressive strength with welded wire fabric reinforcement.

2.5 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

- A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.
- B. Meter Sockets: Comply with requirements of electrical power utility company.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange during progress of construction to facilitate the electrical installations that follow.
  1. Set inserts, sleeves, raceways, boxes, etc. in poured-in-place concrete, masonry work, and other structural components as they are constructed.
- B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work.
- C. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.
- D. Coordinate electrical service connections to components furnished by utility companies.
  1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.



2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

### 3.2 ELECTRICAL EQUIPMENT INSTALLATION

- A. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide the maximum possible headroom.
- B. Materials and Components: Install level, plumb, and parallel and perpendicular to other building systems and components, unless otherwise indicated.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components. Connect for ease of disconnecting, with minimum interference with other installations.

### 3.3 ELECTRICAL SUPPORTING DEVICE APPLICATION

- A. Selection of Supports: Comply with manufacturer's written instructions.
- B. Strength of Supports: Adequate to carry present and future loads, times a safety factor of at least four; minimum of 200-lb (90-kg) design load.

### 3.4 SUPPORT INSTALLATION

- A. Install support devices to securely and permanently fasten and support electrical components.
- B. Install individual and multiple raceway hangers and riser clamps to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assemblies and for securing hanger rods and conduits.
- C. Support parallel runs of horizontal raceways together on trapeze- or bracket-type hangers.
- D. Size supports for multiple raceway installations so capacity can be increased by a 25 percent minimum in the future.
- E. Support individual horizontal raceways with separate pipe hangers or clamps.
- F. Install 1/4-inch- diameter or larger threaded hanger rods, unless otherwise detailed.
- G. Spring-steel fasteners specifically designed for supporting single conduits or tubing may be used instead of hangers for 1-1/2-inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings and for fastening raceways to slotted channel and angle supports.
- H. Separately support cast boxes that are threaded to raceways and used for fixture support. Support sheet-metal boxes directly from the building structure or by bar hangers. If bar hangers are used, attach bar to raceways on opposite sides of the box and support the raceway with an approved fastener not more than 24 inches from the box.
- I. Install metal channel racks for mounting cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices unless components are mounted directly to structural elements of adequate strength.
- J. Install sleeves for cable and raceway penetrations of concrete slabs and walls unless core-drilled holes are used. Install sleeves for cable and raceway penetrations of masonry and fire-rated gypsum walls and of

all other fire-rated floor and wall assemblies. Install sleeves during erection of concrete and masonry walls.

- K. Securely fasten electrical items and their supports to the building structure, unless otherwise indicated. Perform fastening according to the following unless other fastening methods are indicated:
1. Wood: Fasten with wood screws or screw-type nails.
  2. Masonry: Toggle bolts on hollow masonry units and expansion bolts on solid masonry units.
  3. New Concrete: Concrete inserts with machine screws and bolts.
  4. Existing Concrete: Expansion bolts.
  5. Steel: Spring-tension clamps on steel.
  6. Light Steel: Sheet-metal screws.
  7. Fasteners: Select so the load applied to each fastener does not exceed 25 percent of its proof-test load.

### 3.5 FIRESTOPPING

- A. Apply firestopping to cable and raceway penetrations of fire-rated floor and wall assemblies to achieve fire-resistance rating of the assembly.

### 3.6 UTILITY COMPANY ELECTRICITY-METERING EQUIPMENT

- A. Install equipment according to utility company's written requirements. Provide grounding and empty conduits as required by utility company.

### 3.7 FIELD QUALITY CONTROL

- A. Inspect installed components for damage and faulty work.

### 3.8 REFINISHING AND TOUCHUP PAINTING

- A. Refinish and touch up paint.
1. Clean damaged and disturbed areas and apply primer, intermediate, and finish coats to suit the degree of damage at each location.
  2. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
  3. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  4. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.9 CLEANING AND PROTECTION

- A. On completion of installation, including outlets, fittings, and devices, inspect exposed finish. Remove burrs, dirt, paint spots, and construction debris.
- B. Protect equipment and installations and maintain conditions to ensure that coatings, finishes, and cabinets are without damage or deterioration at time of Final Acceptance.

END OF SECTION 260500

## SECTION 260519 - CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field Quality-Control Test Reports: From Contractor.

### PART 2 - PRODUCTS

#### 2.1 POWER CONDUCTORS AND CABLES

- A. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.
- B. Conductor Material:
  - 1. Copper complying with NEMA WC70 / ICEA S-95-658 solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.
  - 2. Power and lighting circuitry: Minimum conductor size shall be #12, and maximum conductor size shall be #500 kcmil.
- C. Conductor Insulation Types: Type THHN/THWN-2 complying with NEMA WC70 / ICEA S-95-658.

#### 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
  - 1. For conductors #8 & smaller, use wire-nut type twist connectors.
  - 2. For conductors #6 & larger, use pre-insulated solderless connectors with one spare port(s) for future cable connection.

### PART 3 - EXECUTION

#### 3.1 CONDUCTOR AND INSULATION APPLICATIONS

- A. Service Entrance, Feeders, Branch Circuits: Type THHN/THWN-2, single conductors in raceway.

- B. Control Circuits: Conductors and cables in raceway.

### 3.2 INSTALLATION

- A. Use manufacturer-approved pulling compound or lubricant where necessary. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables, conductors, or raceway.
- C. Identify and color-code conductors and cables according to Section "Electrical Identification".
- D. Shared neutral conductors shall not be used unless specifically indicated so on homerun circuitry designations on the drawings.

### 3.3 CONNECTIONS

- A. Connect equipment, outlet, device, and component connections to wiring systems and to ground. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B. Where tightening torque is indicated as a numeric value on equipment or in installation instructions provided by the manufacturer, a calibrated torque tool shall be used to achieve that indicated torque value, unless the equipment manufacturer has provided installation instructions for an alternative method of achieving required torque.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

### 3.4 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
  - 2. Inspect for physical damage. test conductors and cable for continuity and shorts.
  - 3. Insulation Resistance (Megger) testing for building wire and cable:
    - a. All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500-Volt insulation resistance tester. Insulation resistance testers shall not be electronic type. Insulation resistance testers shall be hand crank or power-driven crank type. Minimum readings between conductors and between conductor and the grounded metal raceway shall be: 25 mega-ohms for #6 wire and smaller; 50 mega-ohms for #4 wire or larger.
    - b. The CONTRACTOR shall correct malfunctioning conductors and cables, including replacement if necessary, and retest to demonstrate compliance.
    - c. Certify compliance with test parameters.
  - 4. Control / Signal Transmission Media Tests:
    - a. Test cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

- b. Correct malfunctioning conductors and cables at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.
- B. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
  - 4. Provide tabulated insulation resistance readings for each panel circuit.
- C. Witness Tests:
  - 1. The CONTRACTOR shall furnish an insulation resistance tester and show Design Team representative and/or Owner that the conductors comply with the specified requirements.

END OF SECTION 260519

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## SECTION 260526 - GROUNDING AND BONDING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

#### 1.3 SUBMITTALS

- A. Product Data: For the following:
  - 1. Ground rods.
  - 2. Connection / test / inspection wells.
- B. Field Test Reports: Submit written test reports to include the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Comply with UL 467.

### PART 2 - PRODUCTS

#### 2.1 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Section "Conductors and Cables."
- B. Grounding Electrode Conductors: Stranded cable.
- C. Bare Copper Conductors: Comply with the following:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Assembly of Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
- D. Grounding Bus:
  - 1. Bare, annealed copper bars of rectangular cross section .
  - 2. ¼" thick, 4" wide, length as required or minimum length as detailed.
  - 3. Stand-off insulator mounting brackets.

## 2.2 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

## 2.3 GROUNDING ELECTRODES

- A. Ground Rods: Sectional type; copper-clad steel, 3/4" diameter by 120 inches in length.
- B. Connection / Test / Inspection Wells: Provide handholes as specified below:
  - 1. Cylinder, minimum dimensions of 10" diameter x 10" deep, PVC, with cover.
  - 2. Box, minimum dimensions of 12" x 12" x 12" deep with cover, green PVC or polyethylene.

## 2.4 AIRCRAFT GROUNDING RECEPTACLES

- 1. Aircraft Grounding Receptacles with Ball Studs.
  - a. For use in static grounding for aircraft.
  - b. Copper alloy castings.
  - c. 5/8" or 3/4" brass ball stud.
  - d. Direct threaded coupling to 3/4" ground rod.
  - e. Bronze cover plate with chain retainer.

# PART 3 - EXECUTION

## 3.1 APPLICATION

- A. In raceways, use insulated equipment grounding conductors.
- B. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
- C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
- D. Use insulated spacers; space 1 inch minimum from wall and support 12 inches above finished floor, unless otherwise indicated.
- E. Underground Grounding Conductors: Use bare, tinned, stranded-copper conductors. Bury a minimum of 24 inches below grade or bury 12 inches above duct bank when installed as part of a duct bank.

## 3.2 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and circuits.



### 3.3 INSTALLATION

#### A. Ground Rods:

1. For service entrance, install a minimum of two rods spaced at least twenty-two feet from each other and located at least the same distance from other grounding electrodes.
2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds for connections to ground rods. Make connections without exposing the ground rod steel.

#### B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

#### C. Building Steel: Provide insulated copper grounding conductor, in conduit, from building's main service equipment, or grounding bus, to building steel. Connect grounding conductors to building steel by bolted compression lug.

#### D. Metal Water Service Pipe: Provide insulated copper grounding conductor, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Connection shall be made within the first five feet of where the water service line enters the building. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting.

#### E. Where grounding electrode conductors are installed in metal conduit, bond metal conduit to conductor at each end with a grounding bushing.

#### F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, Paragraph 250.52(A)(3), using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. If using structure concrete foundation, and it is less than 20 feet long, coil excess conductor within the base of the foundation. Bond conductor to reinforcing steel. Extend grounding conductor below grade (12") and connect to building grounding ring or to a grounding electrode external to concrete (4" in depth).

### 3.4 CONNECTIONS

#### A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

#### B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

### 3.5 FIELD QUALITY CONTROL

#### A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at service disconnect enclosure grounding terminal or main ground bar, at ground test wells, and at any other location where a maximum ground-resistance level is specified. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
  - a. Perform tests by the fall-of-potential method according to IEEE 81; or
  - b. Perform tests with a clamp-on ground tester.
3. Maximum grounding electrode system resistance values:
  - a. Equipment Rated 500 kVA and Less: 10 ohms.
4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and take corrective action to reduce ground resistance to comply with specified values. Demonstrate compliance by retesting.

END OF SECTION 260526

## SECTION 260533 - RACEWAYS AND BOXES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
  - 1. Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
  - 2. Section "Wiring Devices" for devices installed in boxes.

#### 1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. FMC: Flexible metal conduit.
- C. HDPE: High density polyethylene.
- D. LFMC: Liquidtight flexible metal conduit.
- E. RNC: Rigid nonmetallic conduit.

#### 1.4 SUBMITTALS

- A. Product Data: For raceways, fittings, wireways, floor boxes, hinged-cover enclosures, and cabinets.

#### 1.5 FIELD CONDITIONS

- A. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

### PART 2 - PRODUCTS

#### 2.1 METALLIC CONDUIT

- A. Rigid Aluminum Conduit: Produced to ANSI C80.5; listed to UL 6A.
- B. Rigid Steel Conduit: Produced to ANSI C80.1; listed to UL 6.
- C. EMT and Fittings: Produced to ANSI C80.3; listed to UL 797.
  - 1. Fittings: Plated-steel, hexagonal, compression type.

- D. FMC: Listed to UL 1.
- E. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

## 2.2 NONMETALLIC CONDUIT AND TUBING

- A. RNC: Produced to NEMA TC 2; listed to UL 651.
  - 1. Schedule 40 and Schedule 80 PVC.
- B. RNC Fittings: Produced to NEMA TC 3; listed to UL 514B; match to conduit or tubing type and material.

## 2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Underground Plastic Utilities Duct:
  - 1. Type EPEC-40 HDPE with integral bare solid copper conductor in duct wall for toneable detection.

## 2.4 METAL WIREWAYS

- A. Listed to UL 870.
- B. Material and Construction: Sheet metal sized and shaped as indicated.
  - 1. Indoors: NEMA 1.
  - 2. Outdoors: NEMA 3R.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Select features as required to complete wiring system and to comply with NFPA 70.
- E. Wireway Covers:
  - 1. Indoors: Hinged type.
  - 2. Outdoors: Flanged-and-gasketed type.
- F. Finish: Manufacturer's standard enamel finish.

## 2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- C. Floor Box, Metallic Recessed Access and Recessed Floor Box Covers:
  - 1. Floor box with provisions for mounting wiring devices below floor surface.
  - 2. Floor box cover shall have provisions for passage of cords to recessed wiring devices mounted within floor box.
  - 3. Recessed configuration shall accommodate device cords plugged in with plugs being completely concealed with the box cover closed.

- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- F. Metal Hinged-Cover Enclosures:
  - 1. Interior Locations: NEMA 250, Type 1 with continuous hinged cover, concealed hinge, and flush latch. Finished inside and out with manufacturer's standard enamel.
  - 2. Exterior Locations: NEMA 250, Type 3R galvanized steel with continuous hinged cover and 3-point latch.
  - 3. Removable interior panel.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

- A. Outdoors:
  - 1. Exposed: Rigid metal.
  - 2. Concealed: Rigid metal.
  - 3. Underground
    - a. Under paved areas, installed prior to completion of pavement work: RNC, encased with a minimum of 3" of concrete on all sides.
    - b. Under paved areas, installed after pavement work is complete: directionally bored HDPE.
    - c. Elsewhere: RNC.
  - 4. For grounding electrode conductors: RNC Schedule 80.
  - 5. Boxes and Enclosures: NEMA 250, Type 3R.
- B. Indoors:
  - 1. Exposed, Higher than 10' AFF: EMT.
  - 2. Exposed, Lower than 10' AFF:
    - a. In Electrical Rooms: EMT.
    - b. Elsewhere: Rigid metal.
  - 3. Concealed:
    - a. Ceilings: EMT.
    - b. Gypboard walls: EMT.
  - 4. Underground feeders and branch circuits: RNC.
  - 5. For grounding electrode conductors: RNC Schedule 80.
  - 6. Boxes and Enclosures: NEMA 250, Type 1.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
- E. Do not install aluminum conduits embedded in or in contact with earth or concrete. For direct burial or concrete encasement or penetrations, coat conduit with asphaltum or bituminous type coating.
- F. EMT shall not be installed where raceway or fittings would be in direct contact with the earth, underground, in/below concrete, exposed to the elements, exposed to severe physical damage, or exposed to severe corrosive influence.

### 3.2 INSTALLATION

- A. Keep raceways a minimum of 6 inches away from runs of flues and hot-water pipes. Install horizontal raceway runs above water piping.
- B. Complete raceway installation before starting conductor installation.
- C. Support raceways as specified in Section "Basic Electrical Materials and Methods."
- D. Install temporary closures to prevent foreign matter from entering raceways.
- E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.
- F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- G. Conceal raceways within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- I. Conduits installed on the inside face of exterior building walls shall be spaced off the wall surface a minimum of 1/4" using strut-type channel or "clamp-backs".
- J. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - 1. Run parallel or banked raceways together on common supports.
  - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- K. Join raceways with fittings designed and approved for that purpose and make joints tight.
- L. Raceway connectors shall be insulated throat type. If uninsulated throat connectors are installed, use insulating bushings to protect conductors.
- M. Expansion Fittings:
  - 1. Where raceways of any type pass a building or structure expansion joint, a standard expansion fitting shall be provided and installed. Review architectural and structural drawings for locations of expansion joints.
  - 2. Where raceways installed are subject to temperature swings, install expansion fittings spaced in accordance with manufacturer instructions and NFPA 70 requirements.
  - 3. Expansion fittings shall be compatible with the type of raceway being used.
- N. Terminations:
  - 1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
  - 2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
  - 3. Where using boxes with concentric, eccentric, or over-sized knockouts; provide bonding bushings and jumpers. Size bonding jumpers in accordance with NEC Table 250-122, connecting to the box with ground lugs.

- O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Label each end of pull wires with location of opposite end.
- P. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
- Q. Flexible Connections:
  - 1. Use maximum of 72 inches of flexible conduit for pendant hung lighting fixtures.
  - 2. Use maximum of 24 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors.
- R. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- S. Set floor boxes level and flush with finished floor surface.

### 3.3 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings and finishes are without damage or deterioration at time of Final Acceptance.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### 3.4 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.
  - 1. Exposed threads on galvanized conduits and fittings, installed outdoors, shall be coated with galvanizing paint or equivalent protective coating.

END OF SECTION 260533

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## SECTION 260553 - ELECTRICAL IDENTIFICATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes electrical identification materials and devices intended to comply with NFPA 70, OSHA standards, and authorities having jurisdiction.

#### 1.3 SUBMITTALS

- A. Product Data:
  - 1. For each electrical identification product indicated.
  - 2. For double coated, adhesive tape product indicated.

#### 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 for color-coding.

### PART 2 - PRODUCTS

#### 2.1 CABLE LABELS

- A. Colored Adhesive Tape: Self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches.
- B. Underground-Line Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape.
  - 1. Not less than 6 inches wide by 4 mils thick.
  - 2. Compounded for permanent direct-burial service.
  - 3. Embedded continuous metallic strip or core.
  - 4. Printed legend indicating type of underground line.

#### 2.2 NAMEPLATES AND SIGNS

- A. Engraved Plastic Nameplates and Signs: Engraving stock, plastic laminate, minimum 1/16" thick for signs up to 20 sq. in. and 1/8" thick for larger sizes.
- B. Fasteners for Nameplates and Signs:
  - 1. High performance, double coated tape with adhesive. Design Basis: 3M #06383, or approved equivalent.
  - 2. Two-part epoxy adhesive.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Identification Materials and Devices: Install at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Lettering, Colors, and Graphics: Coordinate names, abbreviations, colors, and other designations with corresponding designations in the Contract Documents or with those required by codes and standards. Use consistent designations throughout Project.
- C. Sequence of Work: If identification is applied to surfaces that require finish, install identification after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before applying.
- E. Circuit Identification Labels on Boxes: Panel and circuit number.
  - 1. Interior Boxes:
    - a. Exposed: Pressure-sensitive, self-adhesive plastic label on cover.
    - b. Concealed:
      - 1) Pressure-sensitive, self-adhesive plastic label on cover; or
      - 2) Permanent marker on cover, legible in a standing position by Design Team and Owner.
  - 2. Exterior Boxes:
    - a. Engraved plastic label on cover; and
    - b. Pressure-sensitive, self-adhesive plastic label inside cover.
- F. Paths of Underground Electrical Lines: During trench backfilling, for exterior underground power, control, signal, and communication lines; install continuous underground-line warning tape located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope does not exceed 16 inches overall, use a single line marker. Install line marker for underground wiring, both direct-buried cables and cables in raceway.
- G. Color-Coding of Phase, Neutral, and Ground Conductors: Use the following colors for service, feeder, and branch-circuit phase conductors:

Configuration	Phase A	Phase B	Phase C	Neutral	Ground
120/240-V, 1 Ph, 3W	Black	Red	N/A	White	Green

  - 1. For conductors #6 AWG and smaller, factory apply color the entire length of conductors.
  - 2. For conductors #4 AWG and larger, field apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors specified. Adjust tape bands to avoid obscuring cable identification markings.
  - 3. At each panelboard, a color code legend shall be permanently posted corresponding to the conductors and voltage in that panelboard.
- H. Apply identification to conductors as follows:
  - 1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
  - 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color-coding to identify circuits' voltage and phase.

3. Multiple Control and Communication Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color-coding, or cable marking tape.
- I. Equipment Identification Labels: Engraved plastic laminate. Install on each unit of equipment. Attached engraved labels with high performance double coated adhesive tape or two-part epoxy adhesive. Apply labels for each unit of the following categories of equipment:
  1. Panelboards, electrical cabinets, and enclosures.
  2. Disconnect switches and enclosed circuit breakers.
  3. Inverters.
  4. Contactors.
  5. Control devices and push-button stations.
  6. Transfer switches.
  7. Fire alarm control panels, master stations, control panels, local operator consoles, and power supplies.
  8. Emergency responder communication coverage system.
- J. Nameplate colors shall be: White surface with black core.

END OF SECTION 260553

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## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.3 DEFINITIONS

GFCI: Ground-fault circuit interrupter.

GFEP: Ground-fault equipment protection.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Trim types and details.
    - c. Bus configuration, current, and voltage ratings.
    - d. Short-circuit current rating of panelboards and overcurrent protective devices.
    - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- C. Panelboard Directories: For installation in panelboards.
- D. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Comply with NEMA PB 1.

## 1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

## 1.7 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. Keys: Six spares for each type of panelboard cabinet lock.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Panelboards, Overcurrent Protective Devices, and Accessories:
    - a. ABB / G.E.
    - b. Eaton Corporation; Cutler-Hammer Products.
    - c. Siemens Energy & Automation, Inc.
    - d. Square D.

### 2.2 MANUFACTURED UNITS

- A. Enclosures: Flush- and surface-mounted cabinets, as scheduled in the drawings.
  - 1. Rated for environmental conditions at installed location.
    - a. Typical Indoor Locations: NEMA 250, Type 1.
      - 1) Front Hinged Cover: Entire front trim hinged to box with full-length piano hinge, and with standard door within hinged trim cover.
      - 2) Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.
    - b. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Front Cover: Doors with concealed hinges; secured with flush latch with tumbler lock; keyed alike.
  - 3. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
- B. Phase Buses:
  - 1. Material: Hard-drawn copper, 98 percent conductivity.
- C. Ground and Neutral Bars:
  - 1. Material: Copper.
  - 2. Equipment Ground Bar: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
  - 3. Neutral Bar: Adequate for feeder and branch-circuit neutral conductors.
- D. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.
  2. Ground Lugs and Bus Configured Terminators: Mechanical or compression type.
- E. Feed-Through Lugs (where scheduled): Mechanical type suitable for use with conductor material.
- F. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- G. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices. These locations will be indicated as SPACE on the panel schedules in the drawings.

## 2.3 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

## 2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Main Overcurrent Protective Devices: Circuit breaker, where scheduled.
- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- C. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. GFCI Circuit Breakers: 5-mA trip sensitivity for personnel protection; single- and two-pole configurations.
  3. GFEP Circuit Breakers: 30-mA trip sensitivity for equipment protection; single- and two-pole configurations.
- D. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
  2. Multipole units enclosed in a single housing or factory-assembled to operate as a single unit.
  3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Panel breaker configurations shall be installed as indicated on the panel schedules or as noted. Breaker position revisions will not be accepted unless approved in writing by the Engineer.

- E. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- F. Install filler plates in unused spaces.

### 3.2 IDENTIFICATION

- A. Create a directory to indicate installed circuit loads. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- B. Panelboard Nameplates: Label each panelboard with laminated-plastic nameplate mounted as specified in Section "Electrical Identification".

### 3.3 CONNECTIONS

- A. Ground equipment according to Section "Grounding and Bonding".
- B. Connect wiring according to Section "Conductors and Cables".

### 3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
  - 3. Neutral-ground bond testing: After all fixtures, devices and equipment are installed and all connections completed to each panel, the CONTRACTOR shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and grounded enclosure. If this reading is less than 25 mega-ohms, the CONTRACTOR shall disconnect the branch circuit neutral wires from the neutral bar. The CONTRACTOR shall then test each one separately to the panel until the low reading ones are found. The CONTRACTOR shall correct troubles, re-connect, and re-test until at least 25 mega-ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in manufacturer's installation instructions for molded-case circuit breakers.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

### 3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 262416



## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Single and duplex receptacles and ground-fault circuit interrupter receptacles.
  - 2. Single- pole snap switches and dimmer switches.
  - 3. Device wall plates.
  - 4. Floor service outlets.

#### 1.3 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wiring Devices:
    - a. Bryant Electric, Inc./Hubbell Subsidiary.
    - b. Eagle Electric Manufacturing Co., Inc.
    - c. Hubbell Incorporated; Wiring Device-Kellems.
    - d. Leviton Mfg. Company Inc.
    - e. Lutron.
    - f. Pass & Seymour/Legrand; Wiring Devices Div.
  - 2. Floor Service Outlets:
    - a. Hubbell Incorporated; Wiring Device-Kellems.
    - b. Pass & Seymour/Legrand; Wiring Devices Div.
    - c. Square D/Groupe Schneider NA.
    - d. Thomas & Betts Corporation.
    - e. Wiremold Company (The).

## 2.2 RECEPTACLES

- A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596, and UL 498.
- B. Straight-Blade and Locking Receptacles:
  - 1. Heavy-Duty grade.
  - 2. Arranged for back and side wiring with brass screws.
  - 3. Grounding type with hex head ground screw terminal.
  - 4. 15-amp and 20-amp, 125-Volt and 250-Volt receptacles in damp or wet locations shall be listed weather-resistant type.
  - 5. Receptacles shall accommodate back and side wiring and shall be grounding type with separate single or double grounding screw terminals.
- C. GFCI Receptacles:
  - 1. Straight blade, feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle.
  - 2. Comply with UL 498 and UL 943.
  - 3. Design units for installation in a 2-3/4-inch-deep outlet box without an adapter.
- D. Industrial Heavy-Duty Pin and Sleeve Devices: Comply with IEC 309-1. Match owner's equipment where indicated.

## 2.3 SWITCHES

- A. Toggle Switches: Comply with UL 20.
  - 1. Heavy-Duty grade, quiet type without the use of mercury switches.
  - 2. Arranged for back and side wiring with brass screws.
  - 3. Grounding type with hex head ground screw terminal.
  - 4. Types:
    - a. Single-pole.
    - b. Double-throw, momentary-contact, center-Off: For use as equipment control.
- B. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
  - 1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.

## 2.4 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
  - 1. Size: All plates shall be oversized / jumbo with matching vertical dimension.
  - 2. Plate-Securing Screws: Metal with head color to match plate finish.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Wet Locations: Cast aluminum, weatherproof, "in-use" type. Receptacle box covers shall be weatherproof whether or not a cord & plug are inserted or not.
  - 5. Toggle Switch Serving as a Disconnect: Wallplate shall be configured with brackets on both sides of the switch to accommodate a padlock to secure the switch in the Off position.

## 2.5 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6, Configuration 5-20R, unless otherwise indicated.

## 2.6 FINISHES

- A. Color:
  - 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install devices and assemblies level, plumb, and square with building lines.
  - 1. Installation height shall be as detailed in the drawings.
- B. Install unshared neutral conductors online and load side of dimmers according to manufacturers' written instructions.
- C. Arrangement of Devices: Mount flush unless noted otherwise:
  - 1. Receptacles over counters, backsplashes, etc. shall be mounted with long dimension horizontal.
  - 2. Mount with long dimension vertical, and with grounding terminal of receptacles on top.
  - 3. Group adjacent switches under single, multigang wall plates.
- D. Remove wall plates and protect devices and assemblies during painting.

### 3.2 IDENTIFICATION

- A. Comply with Section "Electrical Identification."
  - 1. Receptacles and Switches: Identify panelboard and circuit number from which served. Use hot, stamped / thermal printing with black-filled lettering on face of plate, and durable wire markers inside outlet boxes.

### 3.3 CONNECTIONS

- A. Ground equipment according to Section "Grounding and Bonding".
- B. Connect wiring according to Section "Conductors and Cables".

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections:

1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
2. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 262726

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Molded-case circuit breakers (MCCBs).
  - 4. Enclosures.

### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. 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.
  - 2. Enclosure types and details for types other than UL 50E, Type 1.
  - 3. Current and voltage ratings.
  - 4. Short-circuit current ratings (interrupting and withstand, as appropriate).
  - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

### 1.3 CLOSEOUT SUBMITTALS

- A. Warranty documentation.
- B. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. If Section "Operation and Maintenance Data" is included in the project manual, in addition to items there, include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - 2. Time-current curves, including selectable ranges for each type of circuit breaker.
  - 3. Circuit breaker trip settings.

### 1.4 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion; full coverage for labor, materials, and equipment.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Manufacturers:

1. ABB / G.E.
2. Eaton Corporation; Cutler-Hammer Products.
3. ESL Power Systems.
4. Hubbell.
5. Legrand.
6. Siemens Energy & Automation, Inc.
7. Square D/Group Schneider.

- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

## 2.2 FUSIBLE and NON-FUSIBLE SWITCHES

### A. Type HD, Heavy Duty:

1. Single throw.
2. Pole quantity, voltage, and Amperage as required for circuit controlled.
3. UL 98 and NEMA KS 1, horsepower rated. Where fused, clips or bolt pads shall accommodate fuses rated for the nameplate rating of equipment controlled.
4. Lockable handle with provisions to lock in either the On or OFF position 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. Service-Rated Switches: Labeled for use as service equipment.
4. Lugs: Suitable for number, size, and conductor material as indicated in the drawings.

## 2.3 DOUBLE THROW SWITCHES

### A. Pole quantity, voltage, and Amperage as required for circuit controlled.

### B. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.

### C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Lugs: Suitable for number, size, and conductor material as indicated in the drawings.
  - a. Connectors for generator connection as indicated in the drawings.

## 2.4 MOLDED-CASE CIRCUIT BREAKERS

### A. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

### B. 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.

C. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Suitable for number, size, trip ratings, and conductor material.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish:
1. Indoor Locations: UL 50E Type 1.
  2. Outdoor Locations: UL 50E Type 3R.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 INSTALLATION

- A. Comply with manufacturer's published instructions.
- 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.
1. Install fuses in fusible devices.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Electrical Identification."
1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
  2. Label each enclosure with engraved-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Visual and Mechanical Inspection:
    - a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.

- b. Inspect physical and mechanical condition.
  - c. Inspect anchorage, alignment, grounding, and clearances.
  - d. Verify that unit is clean. Clean interior with vacuum, not compressed air.
  - e. Inspect exposed surfaces and repair damaged finishes.
  - f. Inspect bolted electrical connections for high resistance. 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 lowest value.
  - g. Switches:
    - 1) Verify blade alignment, blade penetration, travel stops, and mechanical operation.
    - 2) Verify that fuse sizes and types match the Specifications, Drawings, and equipment nameplate rating requirements.
    - 3) Verify that each fuse has adequate mechanical support and contact integrity.
  - h. Circuit Breakers:
    - 1) Operate circuit breaker to ensure smooth operation.
    - 2) Inspect operating mechanism, contacts, and chutes in unsealed units.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with 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 lowest value.
  - b. Circuit Breakers:
    - 1) Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of shunt trip and close coils must be as indicated by manufacturer.

B. Nonconforming Work:

- 1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- 2. Remove and replace defective units and retest.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

3.6 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262816



## SECTION 263213 - ENGINE GENERATORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes packaged engine-generator sets for optional standby power supply. Include the following features:
  - 1. Diesel engine.
  - 2. Unit-mounted cooling system.
  - 3. Unit-mounted control and monitoring.
  - 4. Performance requirements for sensitive loads.
  - 5. Fuel system.
  - 6. Outdoor enclosure.
- B. Related Requirements:
  - 1. Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

#### 1.3 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. ECM: Engine Control Module.
- C. Optional Standby Power Supply: NEC 702, Optional Standby Systems.
- D. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

#### 1.4 SUBMITTALS

- A. PDF files of submittal data shall be provided.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product, standard accessories, and optional accessories.
  - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 2. Include motor starting performance curve(s) indicating voltage drop for motor starting conditions.
  - 3. Include thermal damage curve for generator.
  - 4. Include time-current characteristic curves for generator protective devices.
  - 5. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.
  - 6. Include generator efficiency at 0.8 power factor at 0.5, 0.75 and 1.0 times generator capacity.

7. Include air flow requirements for cooling and combustion air in cfm at 0.8 power factor and rated load. Testing shall be performed per ISO3046 standards. Provide drawings showing requirements and limitations for location of air intake and exhausts.
8. Include generator characteristics, including, but not limited to kw rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine-generator set, subbase fuel tank, enclosure, and other components specified and/or provided. Indicate recommended equipment pad dimensions. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, center of gravity of full assembly, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
5. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment, automatic transfer switch, and functional relationship between all electrical components.

1.6 INFORMATIONAL SUBMITTALS

- A. Specification Compliance Markup: Submit a mark-up copy of this specification with notations and explanations comprehensively showing all deviations and / or exceptions to these Specifications.
- B. Qualification Data: For supplier / installer.
  1. Statement from supplier / installer detailing local service capability, factory-trained service personnel, and details of service response required in accordance with this specification. Reference section 1.9A.31.9A.3 for service response guarantee.
- C. Field quality-control reports.
- D. Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Initial Manual Submittal for Review: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Owner and/or Engineer will comment on whether scope and content of manual are acceptable.
  1. Correct or revise each manual to comply with Owner and/or Engineer comments. Submit copies of each corrected manual as the Final Manual Submittal.
- B. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training.
  1. Format: Submit operations and maintenance manuals in the following formats.
    - a. PDF electronic file. Submit electronic file via email and USB drive.
    - b. Two paper copies in heavy-duty, three-ring, loose-leaf binders. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

- C. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. Data shall be provided and identified that is specific to the site where equipment is installed.
1. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
  2. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
    - a. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents.
    - b. Product information.
    - c. Maintenance procedures.
    - d. Maintenance and service schedules.
    - e. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
    - f. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
    - g. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
    - h. Warranties: Include copies of warranties and lists of circumstances and conditions that would affect validity of warranties. Include procedures to follow and required notifications for warranty claims.
  3. Operation Manuals: Assemble a complete set of operation data indicating operation of each system, subsystem, and piece of equipment not part of a system.
    - a. System, subsystem, and equipment descriptions.
    - b. Operating procedures.
    - c. Wiring diagrams.
    - d. Control diagrams.
    - e. Piped system diagrams.
  4. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  5. Additionally, include the following:
    - a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
    - b. Operating instructions laminated and mounted adjacent to generator location.
    - c. Training plan.
    - d. Software for unit controller with diagnostic, troubleshooting, and maintenance functionality.

## 1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: One for every 10 of each type and rating but no fewer than one of each.
  2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
  3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
  4. Paint: Two spray cans of each color.

5. Keys: Four keys for enclosure access doors.
6. Special Tools: Tools unique to the product for standard maintenance, listed by part number in operations and maintenance manual.

## 1.9 QUALITY ASSURANCE

### A. Supplier / Installer Qualifications:

1. Manufacturer and factory authorized representative who is trained and approved by manufacturer.
2. Maintain, within 125 miles or two hours of Lumberton, North Carolina; a factory certified service center capable of providing training, parts, and emergency maintenance repairs.
3. Response for emergency repairs shall be guaranteed to be four hours or less upon receipt of service call notification.
4. Manufacturer's authorized representative shall employ factory-trained and certified service personnel and shall carry single-source responsibility for warranty, parts, and service.

## 1.10 WARRANTY

### A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period at no additional cost to the Owner.

1. Warranty Period: 2 years or 2500 hours, whichever occurs first, from date of start-up and Substantial Completion.

## 1.11 SERVICE CONTRACT

- A. Manufacturer's service representative shall provide a service contract at no additional cost to the Owner for a period of 2 years from date of start-up and Substantial Completion of the generator set installation.
- B. At the Owner's option, the service agreement shall be renewable on a year-to-year basis, thereafter, with costs being paid by the Owner.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Caterpillar.
  2. Cummins.
  3. MTU.
- B. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer. Generator set shall be standard offering from manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

### A. NFPA Compliance:

1. Comply with NFPA 30.
2. Comply with NFPA 37.
3. Comply with NFPA 70.

4. Comply with NFPA 110 requirements for Level 1 emergency power supply system.
- B. UL Compliance: Comply with UL 2200/CSA.
- C. Engine Exhaust Emissions: Comply with EPA Tier 3 requirements and applicable state and local government requirements.
- D. Noise Emission:
  1. At a minimum, sound level measured at a distance of 23 feet from the unit after installation is complete shall be 82 dBA or less.
- E. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
  1. Ambient Temperature: Minus 15 to plus 50 deg C.
  2. Altitude: Sea level to 100 feet.

## 2.3 ASSEMBLY DESCRIPTION

- A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.
- B. EPSS Class: Engine-generator set shall be classified as a Class 72 in accordance with NFPA 110.
- C. Governor: Adjustable isochronous, with speed sensing.
- D. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
  1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
- E. Capacities and Characteristics:
  1. Power Output Ratings: Nominal ratings as indicated on the drawings at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
  2. Output Connections: As indicated on the drawings.
  3. Voltage: As indicated on the drawings.
  4. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component. Nameplate shall be in accordance with NFPA70.
- F. Generator-Set Performance:
  1. Oversizing alternator compared with the rated power output of the engine is permissible to meet specified performance.
    - a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
  2. Steady-State Voltage Operational Bandwidth: 2 percent of rated output voltage from no load to full load.
  3. Transient Voltage Performance:
    - a. Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 3 seconds.
    - b. Not more than 25 percent dip under worst case motor starting conditions. See Informational Submittals, Voltage Drop Calculations for specific step loading criteria.

4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds.
7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
8. Block Load Performance: per NFPA110, the unit shall be able to fully recover from a 100% block load.
9. Excitation System: Performance shall be unaffected by 10% total voltage distortion (THD) caused by nonlinear load.
  - a. Provide permanent magnet excitation (PMG) for power source to voltage regulator.
10. Start Time: Comply with NFPA 110, Type 10, system requirements.

## 2.4 ENGINE

- A. Fuel: Diesel Fuel oil, Grade DF-2.
- B. Engine Rating: Prime mover shall have adequate horsepower to meet the specified kW at the specified site altitude and temperatures. Products that de-rate below specified kW for temperature or altitude shall not be accepted.
- C. Rated Engine Speed: 1800 rpm.
- D. Lubrication System: The following items shall be mounted on engine or skid:
  1. Positive displacement, full pressure lubrication oil pump.
  2. Filter and Strainer: Per manufacturer recommendations.
  3. Dipstick to check oil level.
  4. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Jacket Coolant Heater:
  1. Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity. Heater(s) shall be 3<sup>rd</sup> party listed.
  2. 1500-watts, 120 volt minimum. Provide higher capacity heater as required based on manufacturer requirements for engine size.
  3. Thermostatically controlled to maintain engine coolant at not less than 90 deg F in 32 deg F ambient.
  4. Shut-off valve to simplify replacement of the heater.
- F. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
  1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
  2. Cooling System Sizing: Sized to adequately cool the generator set, including aftercooler, without de-rate to an ambient temperature of 122 deg F (50 deg C) for diesel. Maximum external restriction shall be no greater than 0.5 inch of water column.

3. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
  4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
  5. Blower fan, water pump, thermostat, and radiator duct flange shall properly cool the engines in 105 deg F ambient with up to 0.5 inches H2O static pressure on the fan. Radiator shall include a duct flange adapter for connection to the discharge air vent.
  6. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    - a. Rating: 50-psig maximum working pressure with coolant at 180 deg F (82 deg C), and non-collapsible under vacuum.
    - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.
- H. Starting System: 12 or 24-V electric, with negative ground.
1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
  2. Cranking / Starting Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
    - a. Speed sensing and a second independent starter motor disengagement systems shall protect against starter engagement with a moving flywheel.
  3. Cranking Cycle: As required by NFPA 110 for system level specified.
    - a. Cranking cycle with 15 second ON and OFF cranking periods.
    - b. Overcrank protection designed to open the cranking circuit after 75 seconds if the engine fails to start.
    - c. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
  4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter.
  5. Battery: Lead acid, certified to meet NFPA 110, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
  6. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
  7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
  8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and continuous rating adequate for batteries provided, 35-A minimum.
  9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for lead-acid batteries. Unit shall comply with and be listed to UL 1236 and include the following features:
    - a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain +/- 1% constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates. Fuse protection. Reverse polarity and transient protected.
- e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet with adequate vibration isolation if mounted within the generator set.

## 2.5 DIESEL FUEL-OIL SYSTEM

- A. Comply with NFPA 30.
- B. Flexible fuel lines rated 300 deg F and 100 psi ending in pipe thread.
- C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions. Engine-driven or electric fuel transfer pump capable of lifting fuel 4.7 feet minimum.
- D. Fuel Filtering: Primary fuel filter to remove water and contaminants larger than 10 micron. Secondary filter to remove contaminants larger than 2 micron.
- E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:
  - 1. Fuel-Tank Capacity: Fuel for 48 hours' continuous operation at 100 percent rated power output (200 gallons minimum). Tanks larger than the minimum capacity specified are acceptable.
  - 2. Tank level indicator gauge.
  - 3. Low Fuel Sensing Switch: shall be provided, in accordance with NFPA110, to indicate when less than the minimum fuel necessary for full load running, as required by the specified EPSS class.
  - 4. Leak detection in interstitial space.
  - 5. Vandal-resistant fill cap.
  - 6. Spill containment box for filling location.
  - 7. Normal vent shall extend to 12' above grade. Adequately brace extended vent so that attachment of the vent to the tank is not the sole means of support.
  - 8. Containment Provisions: Comply with requirements of authorities having jurisdiction.
  - 9. Tank shall be production tested to 2 psi.
  - 10. Tank shall be equipped with overfill protection, fuel line check valve, fuel level gauge, low fuel level alarm contact, low fuel level shutdown contact, and fittings for fuel supply, return, fill and vent.
  - 11. The tank shall feature all welded construction and have the structural integrity to support the genset, accessories, and the weather-protective enclosure.

## 2.6 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown with



a programmed 5-minute cooldown period. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Activation of a remote emergency-stop switch also shuts down generator set. When mode-selector switch is in the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.

- B. Provide minimum run time control set for 15 minutes with override only by switching the model-selector switch to Off or by operation of a remote emergency-stop switch. Provide engine cooldown timer, factory set at 5 minutes, to permit unloaded running of the standby set after transfer of the load to normal.
- C. Comply with UL 508A.
- D. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration. Panel shall be powered from the engine-generator set battery.
  - 1. Engine and generator control wiring shall be multi-stranded annealed copper conductors encased by cross-linked polyethylene insulation resistant to heat, abrasion, oil, water, diesel fuel, and antifreeze. Wiring shall be suitable for continuous use at 250 deg F (121 deg C) with insulation not brittle at minus 60 deg F (minus 51 deg C). Cables shall be enclosed in nylon flexible conduit, which is slotted to allow easy access and moisture to escape.
    - a. Engines that are equipped with an electronic engine control module (ECM) shall monitor and control engine functionality and seamlessly integrate with the generator set controller through digital communications. ECM monitored parameters shall be integrated into the genset controllers NFPA 110 alarm and warning requirements.
  - 2. Construction: All circuitry within the control panel shall be individually environmentally sealed to prevent corrosion. Encapsulated circuit boards with surface mounted components and sealed, automotive-style connectors for sensors and circuit board connectors.
- E. Indicating Devices: As required by NFPA 110 for Level 1 system. All ECM fault codes shall be displayed at the generator set controller in standard language; fault code numbers are not acceptable. Utilizing a digital display, including the following:
  - 1. AC voltage: True three-phase sensing.
  - 2. AC current.
  - 3. Frequency.
  - 4. EPS supplying load indicator.
  - 5. DC voltage (alternator battery charging).
  - 6. Engine-coolant temperature.
  - 7. Engine lubricating-oil pressure.
  - 8. Running-time meter.
  - 9. Current and Potential Transformers: Instrument accuracy class.
- F. Protective Devices and Controls in Local Control Panel: Shutdown devices and common visual alarm indication as required by NFPA 110 for Level 1 system, including the following:
  - 1. Start-stop switch.
  - 2. Overcrank shutdown device.
  - 3. Overspeed shutdown device.
  - 4. Coolant high-temperature shutdown device.
  - 5. Coolant low-level shutdown device.
  - 6. Low lube oil pressure shutdown device.
  - 7. Overcrank alarm.
  - 8. Overspeed alarm.

9. Coolant high-temperature alarm.
10. Coolant low-temperature alarm.
11. Coolant low-level alarm.
12. Low lube oil pressure alarm.
13. Lamp test.
14. Contacts for local and remote common alarm.
15. Coolant high-temperature prealarm.
16. Generator-voltage; digitally adjustable via controller, password protected.
17. Fuel tank low-level alarm.
18. Run-Off-Auto switch.
19. Control switch not in automatic position alarm.
20. Low cranking voltage alarm.
21. Battery-charger malfunction alarm.
22. Battery low-voltage alarm.
23. Battery high-voltage alarm.

- G. Remote Emergency Shutdown: Provide remote emergency stop switch on external wall of equipment enclosure at a height suitable for installed location.
- H. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.
- I. The control system shall provide pre-wired customer use dry contact outputs (4 minimum). Customer I/O shall be software configurable providing full access to all alarm, event, data logging, and shutdown functionality. For the initial installation, configure:
1. One relay output shall be configured for a summary indication of pre-alarm / alarm / shutdown conditions.
  2. One relay output shall be configured for RUN indication of the generator.
- J. Programmable Cycle Timer: To start and run the generator for a predetermined time. The timer shall use 14 user-programmable sequences that are repeated in a 7-day cycle. Each sequence shall have the following programmable set points:
1. Day of the week.
  2. Time of the day start.
  3. Duration of cycle.
  4. Option to exercise at reduced speed for quiet test mode.

## 2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.
- B. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with UL 489.
1. Tripping Characteristic: Designed specifically for generator protection.
  2. Trip Rating: Matched to generator output rating.
  3. Trip Settings:
    - a. Selected to coordinate with generator thermal damage curve.

- b. Selected to coordinate with magnetic only, motor circuit protector breaker at a fire pump controller, as applicable.
- c. The instantaneous trip setting shall not exceed the calculated short circuit fault current available from the generator.
- 4. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
- 5. Mounting: Each circuit breaker installed in separate box in accordance with NEC 700 separation of circuits.

## 2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1 and UL2200, sized for 248 deg F (120 deg C) temperature rise above ambient at rated load.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H, vacuum impregnated with epoxy varnish in accordance with MILSPEC 1-24092 for improved fungus and salt spray resistance.
- D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide twelve lead alternator.
- E. Range: Provide broad range of output voltage by adjusting the excitation level.
- F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rated speed, and heat during operation at 110 percent of rated capacity.
- G. Enclosure: Drip-proof.
- H. Instrument Transformers: Mounted within generator enclosure.
- I. Voltage Regulator: Solid-state type on a sealed circuit board, separate from exciter, providing performance as specified and as required by NFPA 110. Must be 3-phase sensing.
  - 1. Voltage Adjustment on Control and Monitoring Panel: Provide plus or minus 10 percent adjustment of output-voltage operating band.
  - 2. Provide anti-hunt provision to stabilize voltage.
  - 3. Isolated to prevent tracking when connected to SCR loads.
- J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- K. Subtransient Reactance: 12 percent, maximum for sites with motor load supplied from VFDs or solid state soft starters.
- L. Excitation: Permanent magnet (PMG) type providing 300 percent current output for up to 10 seconds to a downstream breaker for selective coordination and improved motor starting.

## 2.9 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Vandal-resistant, sound-attenuating, weatherproof housing, wind resistant up to 130 mph. Roof shall be peaked or sloped for water runoff. Access doors shall be positioned to provide adequate access to components requiring maintenance. Instruments and controls shall be mounted within enclosure.

1. Structural Design and Anchorage: Comply with North Carolina Building Code for wind loads up to 130 mph. Enclosure shall be mounted to the subbase fuel tank.
  2. Aluminum alloy, 0.063" thick minimum (14 gauge equivalent).
  3. Enclosure exterior shall be primed and finish coated with powder baked manufacturer standard paint.
  4. Hinged Doors:
    - a. Provide a minimum of two doors per side for operator and service access. A rear door or removable access panel shall provide access to generator end of unit.
    - b. Door Panels: With integral stiffeners, and capable of being removed by one person without tools. In lieu of being removed, hardware that retains doors in fully open position are acceptable.
    - c. Slip-pin hinges and latches stainless steel with nylon spacers.
    - d. Gasketed for weather and rodent protection.
    - e. Handles to have padlocking provisions.
    - f. Door locks, hardware, and fasteners shall be stainless steel. Locks shall be keyed alike
  5. Silencer:
    - a. Located within enclosure.
    - b. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
    - c. Coated to be temperature and rust resistant.
    - d. Integral condensate drain.
    - e. Gas proof, stainless steel, flexible exhaust bellows with threaded NPT or flanged connections.
    - f. All exhaust piping shall be wrapped for personnel protection and to eliminate excessive heat build-up during generator operation.
  6. Assembly Hardware (Nuts and Bolts): Use stainless steel hardware and nylon washers to prevent paint deterioration.
- B. Sound Attenuation: Factory or third party enclosure, designed to meet the following design criteria:
1. Sound attenuated enclosure designed to match the criteria for the silencer. Reference section 2.2.D. Enclosure shall have intake and discharge hoods, as needed, to reduce the mechanical and exhaust noise to an acceptable level.
  2. Sound attenuation materials shall be securely supported, attached, and mechanically held in place; preferably with aluminum perforated metal sheeting.
- C. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers to prevent entry of rain and snow. Screened openings to prevent rodent entry.
- D. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.
- 2.10 VIBRATION ISOLATION DEVICES
- A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

## 2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
  - 1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.
  - 2. Additionally, test and document the following:
    - a. Maximum power (kW).
    - b. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
    - c. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1 -22.40.
    - d. Governor speed regulation under steady-state and transient conditions.
    - e. Voltage regulation and generator transient response.
    - f. Fuel consumption at 1/4, 1/2, 3/4, and full load.
    - g. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
    - h. Three-phase short circuit tests.
    - i. Alternator cooling air flow.
    - j. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
    - k. Endurance testing.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
  - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
  - 2. Test generator, exciter, and voltage regulator as a unit.
  - 3. Full load run.
  - 4. Maximum power.
  - 5. Voltage regulation.
  - 6. Transient and steady-state governing.
  - 7. Single-step load pickup.
  - 8. Safety shutdown.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.
- B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 DELIVERY

- A. Generator equipment shall be shipped to the site as a "single-source" item for which responsibility for overall installation, maintenance, spare parts, and service is through the local factory representative.

- B. Delivery of the generator shall include off-loading and setting the generator in place on a concrete slab. Installation shall include mounting of all accessories specified elsewhere in this specification along with external power and control connections of the unit.

### 3.3 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions.
- B. Equipment Mounting:
  - 1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified and/or as detailed in the drawings.
  - 2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases.
- C. Install packaged engine-generator to provide access, without removing connections or accessories, for periodic maintenance.
- D. Install engine-generator in enclosure with elastomeric isolator pads on concrete base. Secure set as required by the manufacturer.
- E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.
- F. Provide fuel as required for startup, testing, and demonstration.

### 3.4 CONNECTIONS

- A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine-generator to allow service and maintenance.
- B. Connect engine exhaust pipe to engine with flexible connector.
- C. Ground equipment according to Section "Grounding and Bonding."
- D. Connect wiring according to Section "Conductors and Cable." Provide a minimum of one 90 degree bend in flexible conduit routed to the generator set from a stationary element.

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Tests and Inspections:
  - 1. NFPA 30 Fuel Tank Tightness Testing:
    - a. After installation on site and before being placed into service, the fuel tank and connections shall be tested in accordance with NFPA 30 requirements.
    - b. Notify the Design Team and local AHJ and Fire Marshal two weeks prior to scheduled test date to allow observation of the testing.
    - c. Obtain written acceptance of testing from the local AHJ and Fire Marshal.
    - d. Submit two copies of local AHJ and Fire Marshal written acceptance of testing.

2. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in the first two subparagraphs as specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - a. Visual and Mechanical Inspection
    - 1) Compare equipment nameplate data with drawings and specifications.
    - 2) Inspect physical and mechanical condition.
    - 3) Inspect anchorage, alignment, and grounding.
    - 4) Verify the unit is clean.
    - 5) Provide fluids and check levels of fuel, lubricating oil, and antifreeze for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
    - 6) Accessories that normally function while each set is standing by shall be checked prior to cranking the engines. These shall include: block heaters, battery chargers, etc.
  - b. Electrical and Mechanical Tests
    - 1) Test protective relay devices per manufacturer recommendations.
    - 2) Verify phase rotation, phasing, and synchronized operation as required by the application.
    - 3) Start-up test mode to check for exhaust leaks, path of exhaust gases outside buildings, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation.
    - 4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
    - 5) Conduct performance test in accordance with NFPA 110.
    - 6) Verify correct functioning of the governor and regulator.
    - 7) Four hour load bank test with an external load bank as follows: 1 hour @ 50% load, 3 hours @ 100% load. Monitor and record the following data in 15 minute intervals: engine coolant temperature, oil pressure, battery charge level, generator output voltage, amperes, and frequency.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
  - a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
  - b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
  - c. Verify acceptance of charge for each element of the battery after discharge.
  - d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks. Repair leaks and retest until no leaks exist.
6. Voltage and Frequency Transient Stability Tests:
  - a. Use data capture from manufacturer control panel and software for measurements.
  - b. Measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
  - c. Measure voltage and frequency transients for actual site loads, similar to the steps indicated for voltage drop calculation requirements.

- C. Coordinate tests with tests for transfer switches and run them concurrently. Perform automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown.
- D. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.
- E. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Remove and replace malfunctioning units and retest as specified.
- G. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- H. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

### 3.6 MAINTENANCE SERVICE

- A. After the four hour load bank test has been completed:
  - 1. Change the lubrication oil, lubrication oil filters, and fuel filters.
  - 2. Fill fuel tank.
- B. Under the service contract, provide full service and maintenance by certified employees of manufacturer's designated service organization.
  - 1. Quarterly: Include inspection, testing, exercising, and adjustments to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation.
  - 2. Yearly: Along with quarterly activities, include a load bank test for a minimum of 3 hours at 100% load.
  - 3. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
  - 4. Include certification in the Owner's maintenance log of repairs made and proper functioning of all engine and auxiliary systems.

### 3.7 TRAINING

- A. The equipment supplier shall provide training for the facility operating personnel covering operation, maintenance, and repair of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner. Time permitting, training will be tentatively scheduled after start-up.

END OF SECTION 263213



## SECTION 263600 - TRANSFER SWITCHES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes transfer switches rated 600 V and less, including the following:
  - 1. Automatic transfer switches (ATS).

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings:
  - 1. Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
  - 2. Wiring diagrams.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified elsewhere for operation and maintenance Data, include the following:
  - 1. Features and operating sequences, both automatic and manual.
  - 2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than four hours from time of notification.
- B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.
- C. Comply with NEMA ICS 1.
- D. Comply with NFPA 70.
- E. Comply with NFPA 110.
- F. Comply with UL 1008 unless requirements of these Specifications are stricter.

## 1.5 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Owner Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

1. Contactor Transfer Switches:
- a. Emerson; ASCO Power Technologies, LP.
  - b. ABB / GE / Zenith Controls.
  - c. Russelectric, Inc.

### 2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.
- B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
1. Rating: 22,000 AIC.
- C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.
- D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.
- G. Neutral Switching. Where four-pole switches are indicated for 3-phase distribution systems and three-pole switches are indicated for single phase distribution system, provide neutral pole switched simultaneously with phase poles.
- H. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

- I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Section "Electrical Identification."
  - 1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
  - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
  - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

## 2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 2 equipment according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.
- C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.
- E. Automatic Transfer-Switch Features:
  - 1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
  - 2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
  - 3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
  - 4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
  - 5. Test Switch: Simulate normal-source failure.
  - 6. Switch-Position Pilot Lights: Indicate source to which load is connected.
  - 7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    - a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    - b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
  - 8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
  - 9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
  - a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
  - b. Push-button programming control with digital display of settings.
  - c. Integral battery operation of time switch when normal control power is not available.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Floor-Mounting Switch: Anchor to floor by bolting.
  1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support.
- B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.
- C. Identify components according to Section "Electrical Identification."
- D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.
- E. Label transfer switch with short circuit current rating information as required by NEC 702.5.

### 3.2 CONNECTIONS

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner, if necessary to accommodate required wiring.
- B. Ground equipment according to Section "Grounding and Bonding".
- C. Connect wiring according to Section "Conductors and Cables".

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
  - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    - a. Check for electrical continuity of circuits and for short circuits.
    - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    - c. Verify that manual transfer warnings are properly placed.
    - d. Perform manual transfer operation.
  - 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
    - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    - c. Verify time-delay settings.
    - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    - e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
  - 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
    - a. Verify grounding connections and locations and ratings of sensors.
- C. Coordinate tests with tests of generator and run them concurrently.
- D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.
- E. Remove and replace malfunctioning units and retest as specified above.

### 3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.
- B. Coordinate this training with that for generator equipment.

END OF SECTION 263600

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## SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

### 1.1 RELATED DOCUMENTS

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

### 1.2 SUMMARY

- A. Section includes lightning protection system for ordinary structures.

### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
  - 2. Include raceway locations needed for the installation of conductors.
  - 3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
  - 4. Include roof attachment details, coordinated with roof installation.

### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Lightning protection cabling attachments to roofing systems and accessories.
  - 2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
  - 3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.
- B. Qualification Data: For Installer.
- C. Product Certificates:
  - 1. For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.
  - 2. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.
- D. Field quality-control reports.

### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For lightning protection system to include in maintenance manuals.
  - 1. In addition to items specified elsewhere, include the following:
    - a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations.

- b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.

## 1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.
- B. Installer Qualifications: UL-listed installer, category OWAY

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. East Coast Lightning Equipment Inc.
  - 2. ERICO International Corporation.
  - 3. Harger.
  - 4. Heary Bros. Lightning Protection Co. Inc.
  - 5. Independent Protection Co.
  - 6. Preferred Lightning Protection.
  - 7. Robbins Lightning, Inc.
  - 8. Thompson Lightning Protection, Inc.

### 2.2 PERFORMANCE REQUIREMENTS

- A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.
- B. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

### 2.3 MATERIALS

- A. Air Terminals:
  - 1. Copper or Aluminum.
  - 2. 1/2-inch diameter by 24 inches long.
  - 3. Rounded tip.
- B. Class I Main Conductors:
  - 1. Stranded Copper: 57,400 circular mils in diameter.
  - 2. Aluminum: 98,600 circular mils in diameter.
- C. Class II Main Conductors:
  - 1. Stranded Copper: 115,000 circular mils in diameter.
  - 2. Aluminum: 192,000 circular mils in diameter.
- D. Secondary Conductors:
  - 1. Stranded Copper: 26,240 circular mils in diameter.
  - 2. Aluminum: 41,400 circular mils in diameter.



- E. Ground Loop Conductor: Tinned copper.
- F. Ground Rods: Copper-clad steel.
  - 1. Diameter: 3/4 inch.
  - 2. Rods shall be not less than 120 inches long.
- G. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install lightning protection components and systems according to NFPA 780.
- B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.
- C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed systems in NFPA 780.
  - 1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
  - 2. Install conduit where necessary to comply with conductor concealment requirements.
  - 3. Air Terminals & Conductors on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.
- D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

### 3.2 CONNECTIONS

- A. Aboveground concealed and exposed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

### 3.3 CORROSION PROTECTION

- A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.
- B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports and certificates.

END OF SECTION 264113

## SECTION 264313 - SURGE PROTECTION DEVICES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes UL 1449 Type 2 surge protective devices for low-voltage power.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Product Certificates: Signed by manufacturers of surge protective devices, certifying that products furnished comply with the following testing and labeling requirements:
  - 1. UL 1283 certification.
  - 2. UL 1449 listing and classification.
- C. Maintenance Data: For surge protection devices to include in maintenance manuals.
- D. Warranties: Special warranties specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- B. IEEE Compliance: Comply with:
  - 1. IEEE C62.41.1, "Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits".
  - 2. IEEE C62.41.2, "Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits".
  - 3. IEEE C62.45, "Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits".
  - 4. IEEE C62.72, "Guide for the Application of Surge Protective Devices for Low-Voltage (1000V and less) AC Power Circuits".
  - 5. IEEE C62.45, "Standard Test Specifications for Surge Protective Devices for Low-Voltage (1000V and less) AC Power Circuits".
- C. NEC Compliance: Comply with NEC 285, "Surge Protective Devices".
- D. UL Compliance: Comply with:
  - 1. UL 1283, "Electromagnetic Interference Filters".
  - 2. UL 1449, "Transient Voltage Surge Suppressors": latest edition.

## 1.5 PROJECT CONDITIONS

- A. Placing into Service: Do not energize or connect service entrance equipment and panelboards to their sources until the surge protective devices are installed and connected.

## 1.6 COORDINATION

- A. Verify voltage rating of system to be protected by surge protective device.
- B. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

## 1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Final Acceptance.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB / Current Technology, Inc.
  - 2. Eaton Corporation; Cutler-Hammer Products.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Thor Systems, Inc.

### 2.2 SERVICE ENTRANCE SUPPRESSORS

- A. Manufacturer Series:
  - 1. ABB / Current Technology #TG3 Series.
  - 2. Eaton SMP Series.
  - 3. Siemens TPS4\_12 Series.
  - 4. Thor Systems #TSni Series.
- B. Include the following features and accessories:
  - 1. LED indicator lights for power and protection status.
  - 2. Surge Rating: 100kA per mode.
  - 3. ANSI / UL 1449 VPR:
    - a. 120/208V240V: 800V maximum (L-N, L-G, N-G), 1200V maximum (L-L).
    - b. 277/480V: 1200V maximum (L-N, L-G, N-G), 2000V maximum (L-L).
  - 4. Enclosures: NEMA 1.
  - 5. Surge-event operations counter.
- C. Connection Means: Permanently wired.

D. Protection modes:

1. Line to Line.
2. Line to Neutral.
3. Line to Ground.
4. Neutral to Ground.

2.3 ENCLOSURES

- A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTIVE DEVICES

- A. Install devices for panelboards with conductors between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
1. Provide multipole, 30-A circuit breaker as a dedicated disconnect for the suppressor, unless otherwise indicated.

3.2 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
1. After installing surge protective devices, but before electrical circuitry has been energized, test for compliance with requirements.
  2. Complete startup checks according to manufacturer's written instructions.
- B. Repair or replace malfunctioning units. Retest after repairs or replacements are made.

END OF SECTION 264313

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## SECTION 265119 - LED INTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes interior LED luminaires, LED luminaires mounted on exterior building surfaces, materials, finishes, supports.
- B. Related Requirements:
  - 1. Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting contactors.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Arrange in order of luminaire callout designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaires.
  - 4. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
  - 5. Include emergency lighting units, including batteries, chargers, photometric performance data.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

## 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. LED Arrays: Furnish at least one of each type.
  - 2. LED Drivers: Furnish at least one of each type.
  - 3. Diffusers and Lenses: Furnish at least one of each type.
  - 4. Globes and Guards: Furnish at least one of each type.

## 1.8 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

## 1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: 5 years from date of Substantial Completion

# PART 2 - PRODUCTS

## 2.1 LUMINAIRE REQUIREMENTS

- A. Standards:
  - 1. Design Lights Consortium (DLC) qualified products list or ENERGY STAR certified.
  - 2. UL 1598, Standard for Luminaires.
  - 3. Recessed luminaires shall comply with NEMA LE 4.
  - 4. UL Listing: Listed for damp or wet location as applicable.
- B. CRI minimum of 80 CCT.
- C. Rated lamp life of 50,000 hours minimum to L70.
- D. Internal driver.
- E. Input Voltage Tolerance: +/- 10% of nominal rated voltage.



## 2.2 RECESSED CAN DOWNLIGHT

- A. Universal mounting bracket.
- B. Integral junction box with conduit fittings.
- C. Fixtures installed in the building thermal envelope shall be:
  - 1. IC rated.
  - 2. Labeled as having an air leakage rate of not more than 2.0 cfm when tested in accordance with ASTM E283 at a 1.57 psf pressure differential.
  - 3. Sealed with a gasket between the housing and ceiling covering.

## 2.3 EMERGENCY LIGHTING UNITS

- A. General: Self-contained units complying with UL 924.
  - 1. LED lamp heads.
  - 2. Battery: Sealed, maintenance-free, nickel-cadmium or nickel metal hydride type with minimum 10-year nominal life and special warranty. Battery sized to provide emergency illumination for not less than 90 minutes.
  - 3. Charger: Fully automatic, solid-state type with sealed transfer relay.
  - 4. 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.
  - 5. Protective Guard: Where indicated, clear polycarbonate guard protects lamp heads or fixtures.
  - 6. Integral Time-Delay Relay: Holds unit on for fixed interval when power is restored after an outage; time delay permits high-intensity-discharge lamps to restrike and develop adequate output.

## 2.4 EXIT SIGNS

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.
- C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
  - 1. Battery: Sealed, maintenance-free, nickel-cadmium or nickel metal hydride type with special warranty. Battery sized to provide emergency illumination for not less than 90 minutes.
  - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  - 3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

## 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: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.

## 2.6 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.

## 2.7 LUMINAIRE SUPPORT

- A. Comply with requirements in Section "Basic Materials and Methods" for channel and angle iron supports.
- B. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- C. Rod Hangers: 3/16-inch minimum diameter, threaded, stainless-steel rod.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 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 vertical force of 400 percent of luminaire weight.
- E. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

F. Ceiling-Grid-Mounted Luminaires:

1. Fixture is to be supported at two (2) opposite ends to the steel frame of the building using the same type of wire as used to support the lay-in ceiling track.
2. Support Clips:
  - a. Fasten fixtures to ceiling grid main runner members with manufacturer clips.
3. Fixtures of Sizes Less Than Ceiling Grid Pattern:
  - a. Install as indicated on reflected ceiling plans or center in acoustical panel.
  - b. Support fixtures independently with at least two 3/4-inch (metal channels spanning and secured to ceiling tees.
  - c. Fixture is to be supported at two (2) opposite ends to the steel frame of the building using the same type of wire as used to support the lay-in ceiling track.
4. Luminaire support wires shall be color coded and tagged to be distinguishable from the grid support wires.

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 normal transfer to battery power source and retransfer to normal. Perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes. The battery test shall demonstrate compliance with the requirements of NEC 700.12(F). Repair and/or replace any units that fail the test, then retest.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION 265119

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## SECTION 265613 - LIGHTING POLES AND STANDARDS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes: Poles and accessories for support of luminaires.

#### 1.3 DEFINITIONS

- A. EPA: Equivalent projected area.
- B. Luminaire: Complete lighting fixture.
- C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.
- D. Standard: See "Pole."

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each pole, accessory, and luminaire-supporting device, arranged as indicated.
  - 1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
  - 2. Include finishes for lighting poles and luminaire-supporting devices.
  - 3. Anchor bolts.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Detail fabrication and assembly of pole accessories.
  - 4. Anchor bolt templates keyed to specific poles and certified by manufacturer.
  - 5. Method and procedure of pole installation. Include manufacturer's written installation instructions.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: Manufacturer's standard warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

## 1.7 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.
  - 1. Where a manufacturer is unable to provide third-party agency labeled products from the factory, the manufacturer shall be responsible for obtaining and providing field evaluation and labeling services of a third-party agency that is accredited by the NCBCC.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Package aluminum poles for shipping according to ASTM B660.
- B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- C. Retain factory-applied pole wrappings on poles until installation is underway. Handle poles with web fabric straps.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of poles 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. Structural Characteristics: Comply with AASHTO LTS-6-M.
- B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions.
- 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 height shall be determined by the applicable building code for the project site.
- 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 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B221, Alloy 6061-T6, with access handhole in in pole wall.
  - 1. Shape: Round, tapered.
  - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Brackets for Luminaires: Detachable, cantilever, without underbrace.
  - 1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with stainless-steel bolts.
  - 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Bolted 1/2-inch threaded lug, complying with requirements in Section "Grounding and Bonding", listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.
- E. Fasteners: Stainless 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.
- F. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.
- G. 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.

## 2.3 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 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.
- C. Examine roughing-in for foundation and conduit to verify actual locations of installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 POLE FOUNDATION

- A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange.

#### 3.3 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.
- B. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified on the structural drawing.
- C. Foundation-Mounted Poles: Mount pole with leveling nuts and tighten top nuts to torque level according to pole manufacturer's written instructions.
  - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
  - 2. Grout void between pole base and foundation. Use non-shrink or expanding concrete grout firmly packed to fill space.
  - 3. Use a short piece of 3/8-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- D. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

#### 3.4 GROUNDING

- A. Ground Metal Poles and Support Structures: Comply with requirements in Section "Grounding and Bonding".
  - 1. Install grounding electrode for each pole unless otherwise indicated.
  - 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.



3.5 IDENTIFICATION

- A. Identify and mark poles as detailed.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Perform the following inspections:
  - 1. Inspect poles for nicks, mars, dents, scratches, and other damage.
  - 2. System function tests.

END OF SECTION 265613

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## SECTION 265619 – LED EXTERIOR LIGHTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
  - 2. Luminaire supports.
  - 3. Luminaire-mounted photoelectric relays.
- B. Related Requirements:
  - 1. Section "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

#### 1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
  - 1. Arrange in order of luminaire callout designation.
  - 2. Include data on features, accessories, and finishes.
  - 3. Include physical description and dimensions of luminaire.
  - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
  - 5. Wiring diagrams for power, control, and signal wiring.
  - 6. Photoelectric relays.
  - 7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- 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.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. LED Arrays: Furnish at least one of each type.
  2. LED Drivers: Furnish at least one of each type.
  3. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: Furnish at least one of each type.
  4. Diffusers and Lenses: Furnish at least one of each type.
  5. Globes and Guards: Furnish at least one of each type.

If field replaceable components are not available, furnish at least one fixture of each type in lieu of the extra materials noted above.

#### 1.8 QUALITY ASSURANCE

- A. Provide luminaires from a single manufacturer for each luminaire type.
- B. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

#### 1.10 FIELD CONDITIONS

- A. Verify existing and proposed structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Design Team prior to the start of luminaire installation.

#### 1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.

- b. Faulty operation of luminaires and accessories.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- 2. Warranty Period: 5 years from date of Substantial Completion

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

### 2.2 LUMINAIRE REQUIREMENTS

- A. Source Limitations: Obtain luminaires from single source from a single manufacturer.
- B. Internal driver.
- C. Input Voltage Tolerance: +/- 10% of nominal rated voltage.

### 2.3 LUMINAIRE TYPES

- A. See schedule on drawings.

### 2.4 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: 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. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- E. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- F. Housings:
  - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.

### 2.5 FINISHES

- A. 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

### 3.3 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.
- E. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- F. Coordinate layout and installation of luminaires with other construction.
- G. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- H. Comply with requirements in Section "Conductors and Cables" and Section "Raceways and Boxes" for wiring connections and wiring methods.

### 3.4 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section "Electrical Identification."

### 3.6 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.
  - 3. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- C. Luminaire will be considered defective if it does not pass tests and inspections.

END OF SECTION 265619

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## SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SYSTEM DESCRIPTION

- A. Microprocessor controlled, intelligent reporting fire detection and alarm system.

#### 1.3 SUMMARY

- A. Section Includes:
  - 1. Fire-alarm control unit.
  - 2. System smoke detectors.
  - 3. Addressable interface devices.
  - 4. Power supplies.
  - 5. Digital alarm communicator transmitter.

#### 1.4 DEFINITIONS

AHJ	Authority Having Jurisdiction.
LED	Light-emitting diode.
NICET	National Institute for Certification in Engineering Technologies.
NRTL	Nationally Recognized Testing Laboratory.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the North Carolina State Building Code.
- B. Comply with applicable provisions of NFPA 72, National Fire Alarm Code.
- C. Equipment supplied shall be specifically listed for its intended use and shall be installed in accordance with the manufacturer's instructions.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
  - 1. Firms shall be regularly engaged in the manufacture of fire alarm systems of the types, sizes, and electrical characteristics required for this project.
  - 2. The system shall comply with provisions of UL safety standards pertaining to fire detection and alarm systems. Products and components shall be Listed and Labeled.
  - 3. Fire detection and alarm systems and accessories shall be FM approved.
  - 4. Firms shall maintain factory authorized service organization. Firms shall maintain spare parts stock.
- B. Designer for Preparation of Shop Drawings and Calculations Qualifications:

1. Personnel shall be trained and certified by manufacturer for system design required for this Project.
2. Personnel shall be certified by NICET as fire-alarm Level II (minimum) technician.

C. Installer Qualifications:

1. Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
2. Supervisor of installation shall be certified by NICET as fire-alarm Level II (minimum) technician.
3. Supervisor of installation shall be certified as an authorized representative of the equipment manufacturer.
4. Minimum of 5 years of experience installing fire detection and alarm systems similar in size and scope to this project.

D. Manufacturer's Field Service Technician Qualifications:

1. Personnel shall be certified by NICET as fire-alarm Level II (minimum) technician.
2. Personnel shall be trained and certified by manufacturer for installation of units specifically required for this Project within the most recent 36 months.
3. If not trained by the manufacturer within 36 months (as noted in 2 above), but within 48 months, NICET fire alarm Level III (minimum) technician certification is required.

E. Source Limitations for Fire-Alarm System and Components:

1. Obtain fire-alarm system equipment and components from a single source.
2. For facilities with existing functional systems in place, new components shall be compatible and listed for use with, and operate as, an extension of existing system.

F. 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.

## 1.7 SUBMITTALS

A. Qualification Data:

1. Designer:
  - a. Manufacturer training certification.
  - b. NICET certification
2. Installer:
  - a. Manufacturer training certification.
  - b. NICET certification.
  - c. Authorized representative of equipment manufacturer certification.
  - d. Experience documentation; 5 years of similar size & scope projects.
3. Manufacturer Field Service Technician:
  - a. Manufacturer training certification.
  - b. NICET certification.

B. Product Data:

1. Manufacturer data for each type of product, equipment, device, etc. proposed.
2. For devices, include milliamp (mA) draw and listed minimum voltage required to operate for each type of device.

3. For panels and power supplies, include voltage drop allowed for the panel and power supplies.
  - C. Shop Drawings: For fire-alarm system to demonstrate compliance with project drawings and specifications. Include plans, elevations, sections, details, and attachments to other work.
    1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
    2. Provide floor plans with:
      - a. Final equipment and device locations, including address of each addressable device and notification appliance.
    3. Provide battery calculations.
    4. System Response Matrix: Indicate fire alarm system's actions (outputs) required for each type of alarm, supervisory, and trouble signal.
  - D. Installation Instructions: Manufacturer's detailed installation instructions for Fire Alarm Control Unit, duct mounted smoke detectors, flow switches, tamper switches, supervisory switches, and similar items which require mechanical installation.
  - E. Field quality-control reports.
  - F. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section "Operation and Maintenance Data," include the following:
    1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
    2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
    3. System Status and Programming Report.
    4. Record copy of site-specific software on USB flash drive (thumb drive).
    5. As-built documents.
      - a. Provide duplicates of the shop drawing plans, wiring diagrams, and riser diagrams showing comprehensive and clear field revisions. Include device addresses, terminal numbers where connected to equipment, and wire color codes.
      - b. Provide a drawing with submitted battery and voltage drop calculations. Include a field for entering actual metered values during system testing.
    6. Technical literature for all control equipment, devices, isolation modules, relays, power supplies, alarm/supervisory signal initiating devices, etc. Include maintenance data and parts lists. Include circuit diagrams of all control panels, modules, annunciators, communications panels, etc.
    7. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
      - a. Frequency of testing of installed components.
      - b. Frequency of inspection of installed components.
      - c. Requirements and recommendations related to results of maintenance.
      - d. Manufacturer's user training manuals.
    8. Manufacturer's required maintenance related to system warranty requirements.
    9. Abbreviated operating instructions, framed and mounted at fire-alarm control unit.
- 1.8 SOFTWARE SERVICE AGREEMENT
- A. Comply with UL 864.

- B. Technical Support: Beginning with Final Acceptance, provide software support for one year.
- C. Upgrade Service:
  - 1. Update software to latest version at Project completion.
  - 2. The manufacturer and authorized distributor of the system installed shall maintain software records on the system installed.
  - 3. At no charge, install and program software upgrades that become available within one year from date of Final Acceptance and for the life of the warranty period. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  - 4. For new software versions that correct operating problems or bugs, free upgrades shall be provided during the life of the system.
  - 5. Provide 30 days notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

## 1.9 WARRANTY

- A. Provide parts and labor warranty of one year from the date of final inspection and/or acceptance by the Owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Fire Lite Alarms.
  - 2. Edwards.
  - 3. Notifier.
  - 4. Siemens Building Technologies, Inc.; Fire Safety Division.
  - 5. Silent Knight.

### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  - 1. Smoke detector.
- B. Fire-alarm signal shall initiate the following actions:
  - 1. Record events in the system memory.
  - 2. Identify alarm at fire-alarm control unit with flashing LED, audible piezo-electric signal, and LCD display of alarm point and location.
  - 3. Transmit an alarm signal to the remote alarm receiving station.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
  - 1. Emergency Responder Radio Communications System monitored points.
- 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. Ground or a single break in fire-alarm control unit internal circuits.
  - 4. Break in standby battery circuitry.
  - 5. Failure of battery charging.

6. Abnormal position of any switch at fire-alarm control unit or annunciator.
7. Loss of primary power or abnormal ac voltage at fire-alarm control unit.

E. System Trouble and Supervisory Signal Actions:

1. Initiate visual and audible trouble annunciation at fire-alarm control unit and remote annunciators.
2. Provide adjustable time delay capability of 0 to 60 minutes to delay transmission of the trouble signals. The delay for loss of primary power or abnormal ac voltage shall be 1 to 3 hours.

## 2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit (FACU):

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
  - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
  - b. Include a real-time clock for time annotation of events on the event recorder. Time of day and date shall be retained upon loss of system primary and secondary power.
  - c. The system shall have multiple access levels for Owner authorized personnel to disable individual alarm inputs or normal system responses for alarms, without changing the system's programming.
  - d. Programming and editing of the existing program shall be possible without special equipment and without interrupting alarm monitoring functions.
2. Enclosure:
  - a. 3rd party listed cabinet suitable for surface, flush, or semi-flush mounting.
  - b. Finish: Rust resistant primer and manufacturer standard finish.
  - c. Door hinged on either right or left side (field selectable).
  - d. Door with key lock and glass opening for viewing all indicators.
  - e. Manufacturer's trim kit for flush or semi-flush mounting.
3. Addressable initiation devices that communicate device identity and status (normal, trouble, and alarm conditions).
  - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
  - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
  - c. Alarm Verification: The system shall provide, as a feature, an alternate signal processing algorithm to verify the presence of smoke. The algorithm shall be selectable when programming. The total effective delay created by the algorithm shall not exceed 60 seconds.
4. Signaling Line Circuits (SLC) Interface Boards:
  - a. Integral microprocessor with capability of operating locally in the event of FACU main microprocessor.
  - b. Provides power and communication with devices on SLC circuit loop.
  - c. Receives and processes analog information from all detectors with software to automatically maintain detectors' desired sensitivity levels
  - d. Automatic detector testing and determination of detector maintenance requirements.
5. The system shall retain historical data and device parameters including device sensitivity measurement testing results. The system shall have the capability to display and print device data,

parameters, and sensitivity test results. Trouble indication shall be initiated when any smoke detector approaches 80% of its alarm threshold due to gradual contamination.

- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
1. Annunciator and Display: Liquid-crystal type, backlit, 80 characters, minimum.
  2. Individual, color-coded system status LEDs for AC POWER, SYSTEM ALARM, SYSTEM TROUBLE, and SIGNAL SILENCE.
  3. Keypad: Alphanumeric; arranged to permit entry and execution of field programming, display, and control commands.
  4. Operator interface functions:
    - a. Acknowledge Switch.
    - b. Alarm Silence Switch with a Subsequent Alarm resound feature.
    - c. System Reset Switch.
    - d. System Test Switch.
    - e. Lamp Test Switch.
- C. Circuits:
1. Signaling Line Circuits (SLC): NFPA 72 Class A, no "T" taps.
  2. Initiating Device Circuits (IDC): NFPA 72 Class B.
  3. Digital electronic signals shall utilize check digits or multiple polling to prevent a single ground or open on any SLC from causing system malfunction, loss of operating power, or the ability to report an alarm.
  4. Wiring Methods:
    - a. All fire alarm circuitry shall be in  $\frac{3}{4}$ " minimum metal conduit. Junction boxes and covers not in finished areas shall be painted red.
    - b. SLC addressable loop circuits shall be wired with type FPL/FLLR/FPLP fire alarm cable, 18 AWG minimum, low capacitance, copper, twisted pair. Cable jacket shall have a red jacket with red and black conductor insulation. For underground circuits, use type TC or PLTC cable (PE insulated).
    - c. All other circuits shall be wired with 14 AWG minimum, stranded copper, type THHN/THWN conductors. Color codes follow:
      - 1) Initiating Circuits, General: Red(+) / White(-).
    - d. Splices are allowed only at device terminals or on terminal blocks in cabinets.
    - e. Terminal block screws shall have pressure wire connectors of the self-lifting or box lug type.
    - f. Permanent wire markers shall be used to label connections at the FACU, other control equipment, power supplies, and in terminal cabinets.
    - g. Branch circuit breakers supplying 120 VAC to system equipment shall be physically protected with a breaker handle lock and identified with a  $\frac{1}{4}$ " permanent red dot applied to the breaker handle or exposed body area. The red identification shall not damage the overcurrent protective devices or obscure the manufacturer's markings.
- D. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- E. 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 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.

2. 120V power supply entry point to the FACU enclosure shall be where designated by the manufacturer.
  3. 120V branch breaker shall be physically protected with a handle lock and identified with a 1/4" diameter permanent red dot applied to the breaker handle or exposed body area.
- F. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
1. Batteries:
    - a. Gel-cell, sealed, plate nickel cadmium, maintenance free.
    - b. Minimum of 24 hours standby capacity plus:
  2. Charger: Dual-rate charging techniques for fast battery recharge.
- G. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

## 2.4 SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
  2. Detectors shall typically be two-wire type for connection to an SLC. Four-wire type detectors may be required if connecting to an existing four-wire system.
  3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. 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.
  4. Integral Visual-Indicating Lights: Provide both alarm and power LEDs, flashing under normal conditions. LEDs shall burn steady, controlled by the FACU, to indicate an alarm condition.
  5. 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. Provide terminals in the fixed base for connection of a remote alarm LED.
  6. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
  7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
  8. Test Means: Provide a means to simulate an alarm condition and report to the FACU. Test shall be initiated at the detector (activation of a magnetic switch) or initiated remotely on command from the FACU when in "test" condition.
- B. Photoelectric Smoke Detectors:
1. Use photoelectric / light scattering principal to measure smoke density and send data to the FACU representing analog level of smoke density.
  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.).

## 2.5 ADDRESSABLE INTERFACE DEVICES

### A. Monitor Modules:

1. For use in providing a system address for alarm-initiating devices for wired applications with normally open dry contacts.
2. Provide an LED that flashes under normal conditions, indicating that the monitor module is operational and in regular communication with the FACU.
3. Modules installed in non-conditioned spaces shall be tested, listed, and marked for continuous duty across the range of temperatures and humidity expected at their installed locations.

## 2.6 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

### A. Digital alarm, dual path, cellular communicator transmitter, 4-channel minimum, shall be compatible with and acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

### B. Functional Performance:

1. Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically dial a preset number for a central station, remote supervising station, or proprietary supervising station.
2. When contact is made with central station(s), signals shall be transmitted. If service is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of communications path to the remote alarm receiving station over the communications path.
3. Transmitter shall automatically report communications path restoration to the central station. If service is lost on both communications paths, transmitter shall initiate the local trouble signal.
4. Precedence of signals transmitted to the supervising station shall be: (1) Fire Alarm, (2) Supervisory Signal, (3) Trouble Signal.

### C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Programming device.
2. LED display.
3. Manual test report function and manual transmission clear indication.
4. 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 or loss of power.
5. Low battery.
6. Abnormal test signal.
7. 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.

## 2.7 SURGE PROTECTION

### A. AC Input:



1. Mount in listed enclosure adjacent to branch circuit panelboard. Wind small coil (5 to 10 turns) in branch circuit conductor just downstream of the suppressor connection.
2. Install feed through branch circuit transient suppressor (Ditek #DTK-120S20A, Leviton #51020-WM/DIN, or approved equivalent that is UL 1449 2nd Edition Listed).

## 2.8 SNAP EDGE FRAMES

### A. Description: Mountable Front Load Easy Open Snap Frame

1. Outside edges flip open for quick document changes.
2. Non-glare plastic cover.
3. Design Basis: U-Line #S-2132 Series.
4. For use with operator's instructions and device map.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

#### A. Comply with NFPA 72 for installation of fire-alarm equipment.

#### B. Equipment and Device Mounting:

1. Install fire-alarm control unit with tops of cabinets not more than 72 inches above the finished floor.
2. Install equipment and devices securely attached to walls, ceilings, floors, building structure. Hardware and supports shall be suitable for the load supported. Ceiling mounted devices shall not be supported solely by suspended ceilings.

#### C. Smoke- Detectors:

1. Orient so that the alarm LED is visible from entrance door in room installed.

#### D. Detector Protection:

1. Unless suitably protected from dust, paint, etc.; detectors shall not be installed until final construction clean-up is complete. If contaminated, detectors shall be replaced.

### 3.2 CONNECTIONS

#### A. Make addressable connections with a supervised interface device to the following devices and systems and any others indicated on the drawings. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Supervisory connections at emergency responder radio coverage system.

### 3.3 REMOTE ALARM TRANSMISSION

#### A. The Contractor shall program the DACT, coordinate signal transmission with the supervising station, and verify proper signal receipt by the supervising station.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section "Electrical Identification."
- B. Detectors and modules shall be labeled with unique numbers that are indicated on as-built drawings and permanently mounted on device bases. Labels shall be legible from floor level. Labels shall be printed black lettering on white background and attached to the device base.
- C. Junction and pull box covers shall be labeled to indicate the circuits or function of the conductors contained in the boxes. Labels shall be neatly applied with black lettering on clear background.
- D. Conductors shall be labeled with permanent wire markers at connections at the FACU, other control equipment, power supplies, and terminal cabinets.
- E. Install framed basic operating instructions in a location visible from fire-alarm control unit. Optionally, with Owner concurrence, the instructions may be affixed to the inside of the FACU door.
- F. Floor plans of the fire alarm system installation shall be provided at the FACU.
  - 1. Provide a locked box adjacent to the FACU for plan book storage. Key to match FACU. Label lock box.
  - 2. Floor plans shall include device locations and addresses. Indicate equipment, module, and EOL locations.
  - 3. Provide a legend for symbols used.
- G. NFPA 72 Record of Completion documentation shall be kept inside the FACU, or its kept location shall be permanently indicated inside the FACU on an engraved label.
- H. At all equipment with a 120 VAC power source, provide an engraved label indicating panelboard ID, branch circuit number, and panelboard location. At the FACU, provide an additional engraved label inside the FACU.

### 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.

### 3.6 FIELD QUALITY CONTROL

- A. Programming revisions shall be made only by the Installer.
- B. Final field tests shall be witnessed by authorities having jurisdiction.
- C. Manufacturer's Field Service: Engage a factory-authorized service technician to make connections to the FACU; to program the system; to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- D. Tests and Inspections:
  - 1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

- b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
    2. Conductor Testing: All conductors shall be tested for grounds, opens and shorts prior to termination at panels and installation of detector heads. Conductors shall be megger tested for a minimum of 10 megohms from conductor to ground and conductor to conductor. Provide record of test results to Engineer in advance of acceptance inspection.
    3. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
    4. Test 100% of alarm initiating devices, all software functions, all other system functions including DACT communication, and verify system operational matrix. Notify Owner and Engineer 2 weeks in advance of this test to permit witness observation.
    5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion", NFPA 72, Figure 1-6.2.1 in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72. Submit "Fire Alarm System Record of Completion" to Engineer for delivery to Owner.
    6. After 100% system test and submission of "Fire Alarm System Record of Completion", schedule an AHJ acceptance inspection, a minimum of 2 days after completion of system testing.
  - E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
  - F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
  - G. Prepare test and inspection reports.
- 3.7 TRAINING / DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel for a minimum of 2 hours to adjust, operate, and maintain fire-alarm system. Training schedule must be coordinated to meet the Owner's schedule. Training location will be provided by the Owner.
  - B. As a minimum, training shall cover:
    1. System software multiple access levels via password protection for accommodating Owner capability for disabling individual alarm inputs or normal outputs for alarms without modifying the system programming or affecting operation of the remainder of the system.
    2. Overall system concepts, capabilities, and functions. Training shall be of sufficient detail so that the Owner shall be able to remove any device from service and return to service without the need for the Manufacturer's approval or assistance.
    3. Methods and means of troubleshooting and replacement of all field wiring devices.
    4. Methods and means of troubleshooting the main FACU and field devices for programming, bussing systems, internal panel and unit wiring, circuitry, and interconnections.
    5. Preventative maintenance service techniques and schedules, including historical data trending of alarm and trouble records.
    6. Training documentation and actual system software used for training shall be provided in digital form and left with the Owner at the completion of training.
  - C. Provide two bound copies of training information.

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## SECTION 285000 – EMERGENCY RESPONDER COMMUNICATION COVERAGE SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. In-building radio signal amplification systems.
  - 2. A system shall be provided to cover new buildings.
- B. Related Sections include the following:
  - 1. Section "Basic Electrical Materials and Methods" for supports, anchors, and identification products.
  - 2. Section "Conductors and Cables" for power supply circuitry.
  - 3. Section "Grounding and Bonding".
  - 4. Section "Raceways and Boxes".

#### 1.3 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction
- B. BDA: Bi-Directional Amplifier: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station and in the downlink from the base station to subscriber devices for enhanced signals and improved coverage
- C. DAS: Distributed Antenna System
- D. ERCCS: Emergency Responder Communication Coverage System
- E. FCC: Federal Communications Commission
- F. RF: Radio Frequency

#### 1.4 ACTION SUBMITTALS

- A. RF Surveys / Shop Drawings: Measurement drawings of each floor of the buildings which indicate relative RF field strength for each frequency and band of interest. Submit to both the AHJ and the Engineer.
  - 1. Initial signal strength mapping.
  - 2. Pre-final signal strength mapping.
- B. Shop Drawings:
  - 1. Include plans and details for code compliant, UL Listed, DAS system design for emergency responder radio coverage.

C. Product Data:

1. Include bill of materials for all BDA / DAS equipment and components.
2. Manufacturer product data sheets and cut sheets for all equipment and components.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: Manufacturer's standard warranty.

1.6 CLOSEOUT SUBMITTALS

- A. RF Survey / Shop Drawings: Final installed measurement drawings of each floor of the building which indicate relative RF field strength for each frequency and band of interest.
- B. Operation and Maintenance Data: For all system equipment and components to include in emergency, operation, and maintenance manuals.

1.7 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.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components that fail in materials or workmanship within a specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide an in-building radio signal amplification system to provide complete coverage in the building for the public safety agencies. System shall meet the requirements of:
1. The local AHJ.
  2. FCC.
  3. The North Carolina Fire Code.
  4. NFPA 72, National Fire Alarm and Signaling Code.
    - a. In accordance with NFPA 72, emergency responder radio coverage systems must be designed, installed, and maintained in accordance with NFPA 1221, Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems.
  5. UL 2524, Standard for In-building 2-Way Emergency Radio Communication Enhancement Systems.
- B. All system coaxial cables shall be plenum rated.
- C. Donor antenna cable and riser coaxial cables shall be rated as riser cables and routed through 2-hour-rated enclosures.

- D. Connections between riser coaxial cables and horizontal coax cables to system antennas shall be made within 2-hour-rated enclosures. No taps shall be made outside of the room where the ERCCS equipment is located.

## PART 3 - EXECUTION

### 3.1 RF FIELD SURVEYS

- A. Perform initial signal strength mapping on-site field surveys to determine if a system is required due to inadequate radio signal coverage.
- B. Perform pre-final signal strength mapping on-site field surveys for a final determination of whether or not a system is required. If a system is required, signal strength mapping performed should serve to provide data suitable to prepare system designs.

### 3.2 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.3 INSTALLATION

- A. Install system equipment and components.
- B. Coordinate infrastructure needs for system installation.
- C. Grounding:
  - 1. Ground and bond coax cable shield and associated metallic conduits.
  - 2. Ground and bond coax cable surge suppressor and associated metallic conduits.

### 3.4 IDENTIFICATION

- A. Identify and mark equipment and components with engraved labels as specified in Section "Electrical Identification".

### 3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to:
  - 1. Test and adjust equipment and components.
  - 2. Perform startup and commissioning of system.
- B. Tests and Inspections:
  - 1. Perform final testing for the local inspection authority, including final signal strength mapping.
  - 2. Perform final testing and demonstration with the AHJ.
  - 3. Submit final signal strength mapping results shop drawings.

END OF SECTION 285000

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## SECTION 321720 – DETECTABLE WARNING SURFACES

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Cast in place detectable warning surfaces at exterior sidewalks.

#### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's literature describing products, installation procedures and routine maintenance.
- B. Samples for Verification Purposes: Submit two (2) tile samples minimum 6"x6" of the kind proposed for use.
- C. Shop drawings are required for products specified showing fabrication details, composite structural system, tile surface profile, sound on cane contact amplification feature, plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure.
- D. Material Test Reports: Submit complete test reports from qualified accredited independent testing laboratories to qualify that materials proposed for use are in compliance with requirements and meet or exceed the properties indicated on the specifications. All tests shall be conducted on a Cast In Place Detectable/Tactile Warning Surface Tile system as certified by a qualified independent testing laboratory and be current within a 24 month period.
- E. Maintenance Instructions: Submit copies of manufacturer's specified installation.

#### 1.3 QUALITY ASSURANCE

- A. Provide Cast In Place Detectable/Tactile Warning Surface Tiles and accessories as produced by a single manufacturer with a minimum of three (3) years experience in the manufacturing of Cast In Place Detectable/Tactile Warning Surface Tiles.
- B. Installer's Qualifications: Engage an experienced Installer certified in writing by Cast In Place Detectable/Tactile Warning Surface Tile manufacturer as qualified for installation, who has successfully completed installations similar in material, design, and extent to that indicated for Project.
- C. Americans with Disabilities Act (ADA): Provide Cast In Place Detectable/Tactile Warning Surface Tiles which comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act (Title III Regulations, 28 CFR Part 36 ADA STANDARDS FOR ACCESSIBLE DESIGN, Appendix A, Section 4.29.2 DETECTABLE WARNINGS ON WALKING SURFACES).

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Cast In Place Detectable/Tactile Warning Surface Tiles shall be suitably packaged or crated to prevent damage in shipment or handling. Finished surfaces shall be protected by sturdy plastic wrappings to protect tile from concrete residue during installation and tile type shall be identified by part number.
- B. Cast In Place Detectable/Tactile Warning Surface Tiles shall be delivered to location at building site for storage prior to installation.

#### 1.5 SITE CONDITIONS

- A. Environmental Conditions and Protection: Maintain minimum temperature of 40°F in spaces to receive Cast In Place Detectable/Tactile Warning Surface Tiles for at least 24 hours prior to installation, during installation, and for not less than 24 hours after installation.
- B. The use of water for work, cleaning or dust control, etc. shall be contained and controlled and shall not be allowed to come into contact with the general public. Provide barricades or screens to protect the general public.

#### 1.6 GUARANTEE

- A. Cast In Place Detectable/Tactile Warning Surface Tiles shall be guaranteed in writing for a period of five (5) years (minimum) from date of final completion. The guarantee includes defective work, breakage, deformation, fading and loosening of tiles.

### PART 2 - PRODUCTS

#### 2.1 DETECTABLE WARNING SURFACES

- A. Cast in place composite paver unit with the following attributes
  1. Compliant with ADAAG R304 Regulations for Detectable Warning Surfaces.
  2. Raised truncated domes with a diameter of 0.9", height of nominal 0.2" and a center-to-center spacing of 1.67" minimum to 2.35" maximum.
  3. 2' deep by full width tactile required unit measuring 0.25" nominal thickness with embedment ribs 3" on center. Confirm width and quantities on drawings. Layouts comprised of smaller tiles to achieve full width will not be accepted.
  4. Homogeneous glass and carbon reinforced composite which is colorfast and UV stable suitable for exterior use.
  5. Durable fiberglass reinforced truncated domes.
  6. Uniform color throughout without an applied paint coating.
  7. Color to be selected by Architect from manufacturer's full palette of standard colors.
  8. Size as indicated on drawings.
- B. Attributes:
  1. Compressive strength: 28,900 psi in accordance with ASTM D 695.
  2. Flexural strength: 29,300 psi in accordance with ASTM D 790.

3. Water absorption: 0.07% in accordance with ASTM D 570.
  4. Slip resistance: 1.18 Dry, 1.05 wet in accordance with ASTM C 1028.
  5. Flame spread index: 20, in accordance with ASTM E 84.
  6. Salt spray: No change (200 hours) in accordance with ASTM B 117.
  7. Chemical stain testing: no deterioration in accordance with ASTM 1308.
  8. Abrasion resistance: 549 in accordance with ASTM C 501.
  9. Accelerated weathering: Delta E <5.0 (2,000 hours) in accordance with ASTM G 155.
  10. Tensile strength: 11,600 psi in accordance with ASTM D 638.
  11. Load bearing at 16,000 lbs: No damage in accordance with AASHTO-H2O.
  12. Freeze/Thaw/Heat: No disintegration in accordance with ASTM C 1026.
- C. Subject to compliance with requirements, provide products from one of the following manufacturers:
1. ADA Solutions, Inc.
  2. Armor-Tile.
  3. Detectable Warning System.
  4. Tile Tech Pavers

## PART 3 - EXECUTION

### 3.1 DETECTABLE WARNING SURFACE INSTALLATION

- A. Comply with manufacturer's standard installation instructions.
1. The physical characteristics of the concrete shall be as specified in the drawings while maintaining a slump range of 4-7 to permit the solid placement of the tactile unit in wet cement.
  2. The concrete shall be poured and finished level, true and smooth to the required dimensions prior to the placement of the tactile unit.
  3. Place the tactile unit 6-8 inches from the curb or sidewalk line. Working in a grid pattern, tamp the tactile unit into the wet concrete using a rubber mallet and a piece of wood. Continue this process until all of the air has been released, and the tactile unit is flush with the surrounding area. Avoid striking the surface of the tactile unit directly.
  4. Following the placement, the tactile unit elevation should be checked to the adjacent surface with a straight edge. The tactile unit elevation should be consistent with the contract drawings and specifications. Any required adjustments must be made prior to the time when the concrete begins to set.
  5. When the tactile unit is in place, and no further adjustments are needed, place a cinder block on both ends to hold the tactile unit in place while the concrete sets.
  6. During and after the tactile unit installation, as well as the concrete curing stage, no walking or external forces can be placed on the tactile unit. The area must be protected from pedestrian traffic until the concrete is cured, approximately 1-2 hours.
  7. Remove the plastic protective covering from the face of the tactile unit once the concrete is cured.

### 3.2 CLEANING, PROTECTING AND MAINTENANCE

- A. Protect tiles against damage during construction period to comply with manufacturer's specification.

- B. Protect tiles against damage from rolling loads following installation by covering with plywood or hardwood.
- C. Clean tiles not more than four days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project. Clean tiles by method specified by manufacturer.
- D. Comply with manufacturers' maintenance manual for cleaning and maintaining tile surface and it is recommended to perform annual inspections for safety and tile integrity.

END OF SECTION 321720

# **TECHNICAL SPECIFICATIONS**

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## ITEM C-102

### TEMPORARY AIR AND WATER POLLUTION, SOIL EROSION, AND SILTATION CONTROL

#### DESCRIPTION

- 102-1** This item shall consist of temporary control measures as shown on the plans or as ordered by the ENGINEER during the life of a contract to control pollution of air and water, soil erosion, and siltation through the use of silt fences, berms, dikes, dams, sediment basins, fiber mats, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

Temporary erosion control shall be in accordance with the approved erosion control plan; the approved Construction Safety and Phasing Plan (CSPP) and AC 150/5370-2G, *Operational Safety on Airports During Construction*. The temporary erosion control measures contained herein shall be coordinated with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

Temporary control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, waste areas, and temporary plant sites.

Temporary control measures shall be designed, installed, and maintained to minimize the creation of wildlife attractants that have the potential to attract hazardous wildlife on or near public-use airports.

#### MATERIALS

- 102-2.1 Grass.** Grass that will not compete with the grasses sown later for permanent cover per Item T-901 shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Selected grass species shall not create a wildlife attractant.
- 102-2.2 Mulches.** Mulches may be hay, straw, fiber mats, netting, bark, wood chips, or other suitable material reasonably clean and free of noxious weeds and deleterious materials per Item T-908. Mulches shall not create a wildlife attractant.
- 102-2.3 Fertilizer.** Fertilizer shall be a standard commercial grade and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists.

- 102-2.4 Slope Drains.** Slope drains may be constructed of pipe, fiber mats, rubble, concrete, asphalt, or other materials that will adequately control erosion.
- 102-2.5 Silt Fence.** Silt fence shall consist of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. Synthetic filter fabric shall contain ultraviolet ray inhibitors and stabilizers to provide a minimum of six months of expected usable construction life. Silt fence shall meet the requirements of ASTM D6461.
- 102-2.6 Other.** All other materials shall meet commercial grade standards and shall be approved by the ENGINEER before being incorporated into the project.

### **CONSTRUCTION REQUIREMENTS**

- 102-3.1 General.** In the event of conflict between these requirements and pollution control laws, rules, or regulations of other federal, state, or local agencies, the more restrictive laws, rules, or regulations shall apply.

The ENGINEER shall be responsible for assuring compliance to the extent that construction practices, construction operations, and construction work are involved.

- 102-3.2 Schedule.** Prior to the start of construction, the Contractor shall submit schedules in accordance with the approved Construction Safety and Phasing Plan (CSPP) and the plans for accomplishment of temporary and permanent erosion control work for clearing and grubbing; grading; construction; paving; and structures at watercourses. The Contractor shall also submit a proposed method of erosion and dust control on haul roads and borrow pits and a plan for disposal of waste materials. Work shall not be started until the erosion control schedules and methods of operation for the applicable construction have been accepted by the ENGINEER.
- 102-3.3 Construction Details.** The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the plans and approved CSPP. Except where future construction operations will damage slopes, the Contractor shall perform the permanent seeding and mulching and other specified slope protection work in stages as soon as substantial areas of exposed slopes can be made available. Temporary erosion and pollution control measures will be used to correct conditions that develop during construction that were not foreseen during the design stage; that are needed prior to installation of permanent control features; or that are needed temporarily to control erosion that develops during normal construction practices, but are not associated with permanent control features on the project.



Where erosion may be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately if project conditions permit. Temporary erosion control measures are required if permanent measures cannot immediately follow grading operations. The ENGINEER shall limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finish grading, mulching, seeding, and other such permanent control measures current with the accepted schedule. If seasonal limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible and justified as directed by the ENGINEER.

The Contractor shall provide immediate permanent or temporary pollution control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment as directed by the ENGINEER. If temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or directed by the ENGINEER, the work shall be performed by the Contractor and the cost shall be incidental to this item.

The ENGINEER may increase or decrease the area of erodible earth material that can be exposed at any time based on an analysis of project conditions.

The erosion control features installed by the Contractor shall be maintained by the Contractor during the construction period.

Provide temporary structures whenever construction equipment must cross watercourses at frequent intervals. Pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations, and other harmful materials shall not be discharged into any waterways, impoundments or into natural or manmade channels.

**102-3.4 Installation, Maintenance and Removal of Silt Fence.** Silt fences shall extend a minimum of 16 inches and a maximum of 34 inches above the ground surface. Posts shall be set no more than 10 feet on center. Filter fabric shall be cut from a continuous roll to the length required minimizing joints where possible. When joints are necessary, the fabric shall be spliced at a support post with a minimum 12-inch overlap and securely sealed. A trench shall be excavated approximately 4 inches deep by 4 inches wide on the upslope side of the silt fence. The trench shall be backfilled, and the soil compacted over the silt fence fabric. The Contractor shall remove and dispose of silt that accumulates during construction and prior to establishment of permanent erosion control. The fence shall be maintained in good working condition until permanent erosion control is established. Silt fence shall be removed upon approval of the ENGINEER.

## **METHOD OF MEASUREMENT**

- 102-4.1** Temporary erosion and pollution control work required will be performed as scheduled or directed by the ENGINEER. Completed and accepted work will be measured as follows:
- A.** Temporary Seeding and Mulching will be measured by the Acre.
  - B.** Temporary Construction Entrance will be measured by the Each.
  - C.** Installation and Removal of Silt Fence will be measured by the Linear Foot.
  - D.** Temporary Sod Inlet Protection will be measured by the Each.
  - E.** Temporary Sediment Bag, Including Installation and Removal will be measured by the Each.
  - F.** Concrete Washout Structure Installation and Removal will be measured by the Each.
- 102-4.2** Control work performed for protection of construction areas outside the construction limits, such as borrow and waste areas, haul roads, equipment and material storage sites, and temporary plant sites, will not be measured and paid for directly but shall be considered as a subsidiary obligation of the Contractor.

## **BASIS OF PAYMENT**

- 102-5.1** Accepted quantities of temporary water pollution, soil erosion, and siltation control work ordered by the ENGINEER and measured as provided in Paragraph 102-4.1 will be paid for under:
- Item C-102.5.1      Temporary Seeding and Mulching – per Acre
  - Item C-102.5.2      Temporary Construction Entrance – per Each
  - Item C-102.5.3      Temporary Silt Fence Installation and Removal – per Linear Foot
  - Item C-102.5.5      Temporary Sod Inlet Protection – per Each
  - Item C-102.5.6      Temporary Sediment Bag, Including Installation and Removal will be measured by the Each – per Each

Item C-102.5.7      Concrete Washout Structure Installation and Removal –  
per Each

Where other directed work falls within the specifications for a work item that has a contract price, the units of work shall be measured and paid for at the contract unit price bid for the various items.

Temporary control features not covered by contract items that are ordered by the ENGINEER will be paid for in accordance with Section 90, Paragraph 90-05 *Payment for Extra Work*.

### **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.

#### **Advisory Circulars (AC)**

AC 150/5200-33C      *Hazardous Wildlife Attractants on or Near Airports*

AC 150/5370-2G      *Operational Safety on Airports During Construction*

#### **ASTM International (ASTM)**

ASTM D6461      *Standard Specification for Silt Fence Materials*

#### **United States Department of Agriculture (USDA)**

FAA/USDA      *Wildlife Hazard Management at Airports, A Manual for Airport Personnel*

**END OF ITEM C-102**

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**ITEM C-105**

**MOBILIZATION**

- 105-1 Description.** This item of work shall consist of, but is not limited to, work and operations necessary for the movement of personnel, equipment, material and supplies to and from the project site for work on the project except as provided in the contract as separate pay items.
- 105-2 Mobilization Limit.** Mobilization shall be limited to 10 percent of the total project cost.
- 105-3 Posted Notices.** Prior to commencement of construction activities, the Contractor must post the following documents in a prominent and accessible place where they may be easily viewed by all employees of the prime Contractor and by all employees of subcontractors engaged by the prime Contractor: Equal Employment Opportunity (EEO) Poster "Equal Employment Opportunity is the Law" in accordance with the Office of Federal Contract Compliance Programs Executive Order 11246, as amended; Davis Bacon Wage Poster (WH 1321) - DOL "Notice to All Employees" Poster; and Applicable Davis-Bacon Wage Rate Determination. These notices must remain posted until final acceptance of the work by the Owner.
- 105-4 Engineer's/RPR Field Office.** The Contractor shall provide dedicated space for the use of the field ENGINEER/RPR and Q.A. Testing Laboratory Representatives, as a field office for the duration of the project. This space shall be located conveniently near the construction and shall be separate from any space used by the Contractor.

The field office and appurtenances shall be as described below:

Minimum facilities for the ENGINEER'S Field Office shall include 300 square feet of usable office space. The ENGINEER'S trailer shall include approved sanitary facilities (water and sewer), two (2) desks, two (2) work tables (minimum 30" x 60"), four (4) chairs, lockable file cabinet, electrical hook up, and adequate heating and air conditioning to maintain an ambient temperature of 76°F in the summer and 70°F in the winter.

The Contractor shall provide ENGINEER'S Field Office with a copier and related supplies. All equipment, including copier and unused supplies shall remain the property of the Contractor upon completion of the work. Contractor shall supply a black and white copier and supplies, including but not limited to ink cartridges, toner cartridges, and paper.

The field office shall remain on the project site and be maintained for the duration of this Contract, or until such time that the Contract is completed and accepted by the ENGINEER. The Contractor shall provide materials, equipment, and workmanship of the quality which will provide an installation requiring only normal maintenance, for the duration of the Contract. After completion and acceptance of this Contract, the field office and equipment shall remain the property of the Contractor (unless leased).

The field office and all appurtenances shall be in good repair and good operating condition, to the satisfaction of the ENGINEER, throughout the project. Any equipment which fails or becomes unusable due to the normal wear and tear shall be replaced by the Contractor with a new piece of like equipment, meeting the above requirements. Any costs for repair and replacement shall be the responsibility of the Contractor. The Contractor's obligation for maintenance will not cease until he has received written acceptance of the job by the ENGINEER.

The field office shall be placed at a location in the staging area as approved by the ENGINEER. The location shall be selected which will be convenient to the Contractor's on-site headquarters and which will not conflict with his plan of operation or the operation of subsequent Contractors.

The monthly utility bills shall be paid by the Contractor.

The Contractor shall provide and maintain for the duration of his Contract an all-weather driveway and a parking area for a minimum of five cars. The cost for furnishing and maintaining the ENGINEER's Field Office will be paid for on a monthly basis. The price bill shall include all costs for furnishing and maintaining the office facilities including all setup and utility costs, and all furnishings and miscellaneous appurtenances.]

#### **METHOD OF MEASUREMENT AND PAYMENT**

**105-5.1 Mobilization.** Based upon the contract lump sum price for "Mobilization" partial payments will be allowed as follows:

- A.** With first pay request, 25%.
- B.** When 25% or more of the original contract is earned, an additional 25%.
- C.** When 50% or more of the original contract is earned, an additional 40%.

**D.** After Final Inspection, Staging area clean-up and delivery of all Project Closeout materials as required by Section 90, Paragraph 90-11, *Contractor Final Project Documentation*, the final 10%.

**105-5.2 Engineer's/RPR Field Office.** The ENGINEER's/RPR Field Office will be measured and paid for on monthly basis for time completed office is installed and maintained for use on the project.

#### **BASIS OF PAYMENT**

**105-6 Payment will be Made Under:**

Item C-105.6.1 Mobilization – per Lump Sum

Item C-105.6.2 Engineer's/RPR Field Office – per Month

#### **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.

#### **Office of Federal Contract Compliance Programs (OFCCP)**

Executive Order 11246 (As Amended)

EEOC-P/E-1 Equal Employment Opportunity is the Law Poster

#### **United States Department of Labor, Wage and Hour Division (WHD)**

WH 1321 Employee Rights under the Davis-Bacon Act Poster

#### **END OF ITEM C-105**

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## TEMP TCI

### TEMPORARY CONSTRUCTION ITEMS

#### DESCRIPTION

- TCI-1.1 GENERAL.** This item consists of furnishing all labor, materials, and equipment for temporary construction items necessary for the safe and proper execution of construction and not otherwise included in other Contract items. The Contractor will be expected to supply and utilize the items listed below and other items as required in the Construction Notes or as contained in the drawings and technical specifications. Temporary construction items include, but are not limited to providing and maintaining construction barricades; portable construction lighting; optional temporary haul road construction/maintenance; maintenance of construction access and haul routes along taxilanes; temporary drainage provisions; personnel and vehicles serving construction access tasks (gate keeping, flagging, and escorting, coordinating aircraft access); personnel and equipment as needed to keep all aircraft and/or vehicle traffic areas clean and free of debris.

#### MATERIALS

- TCI-2.1 CONSTRUCTION BARRICADES.** Construction barricades shall be High Density Polyethylene (HDPE) water-ballast barricades and shall be constructed in accordance with the details shown on the plans. Construction barricades shall be placed in accordance with the Construction Safety and Phasing Plans and around all cranes, equipment, and staging areas on the paved areas.
- TCI-2.2 PORTABLE FLOODLIGHTING.** Portable floodlighting shall be provided, as required, for construction operations during nighttime work. The Contractor shall provide sufficient units so that all work areas are illuminated to a level of 5 horizontal footcandles. The lighting levels shall be calculated and measured in accordance with the current standards of the Illumination Engineering Society.
- TCI-2.3 TEMPORARY HAUL ROAD CONSTRUCTION/MAINTENANCE.** Contractor haul routes have been designated on the Plans, and it shall be the Contractor's responsibility to implement construction access along taxilanes and/or the optional haul road as shown and noted on the plans. It shall be the Contractor's responsibility to inspect the existing conditions of the taxilane haul routes prior to construction, and to repair any damage resulting from hauling activities to existing condition or better. Contractor may construct a haul road in general accordance with the alignment, notes and details shown on the plans. During construction, the Contractor shall be responsible for maintaining and repairing the haul road as required or

directed by the ENGINEER. Locations of haul roads shall be restored to their original conditions at the conclusion of construction activities.

The Contractor shall keep all open airfield pavements clear of all debris, stones, etc., during construction. All pavements shall be cleaned of construction debris and spillage immediately. Contractor shall continually inspect pavement crossed or traveled by vehicles during construction operations. Contractor shall maintain suitable equipment for cleaning airfield pavement on site. Contractor shall clean all affected taxiways and crossings as needed or as directed to keep the pavement clean of debris.

- TCI-2.4      TEMPORARY DRAINAGE.** Items required for temporary drainage include, but are not limited to HDPE or PVC pipe, end sections, and grading of swales as required for maintenance of existing or temporary drainage patterns. Temporary drainage pipe shall be in accordance with Specification Section D-701, Pipe for Storm Drains and Culverts.

### **CONSTRUCTION METHODS**

- TCI-3.1      CONSTRUCTION BARRICADES.** Barricades shall be placed in accordance with the construction plans and as needed and shall remain in place or moved as directed until completion of work in each phase or area. The contractor shall be responsible for maintaining the barricades in good working condition throughout the duration of the contract.

- TCI-3.2      PORTABLE FLOODLIGHTING.** Portable floodlighting is required for construction during periods of limited visibility (i.e., nighttime). Illumination requirements shall be those contained in Paragraph 2.2. Portable floodlighting shall not penetrate any operational surfaces. Floodlighting shall be directed to avoid interference with aircraft pilots while taxiing, landing or taking off. Hoods or shields may be required to prevent interference. See additional requirements on the plans.

- TCI-3.3      CONSTRUCTION MATERIALS STOCKPILING AND EQUIPMENT STORAGE.** Stockpiling of construction materials and equipment storage is not permitted within operating taxiway or taxiway object free areas. Stockpiled material must be protected against jet blast and propeller wash. Stockpiled materials and equipment should be prominently marked and lighted during hours of restricted visibility or darkness if in the air operations area. Stockpiled material or equipment should not be stored near aircraft turning areas or operational movement areas, aprons, or excavations and trenches. The stockpiled construction materials and equipment shall not cause degraded or hazardous conditions to Airport operational safety. This includes determining and verifying that stockpiled materials and equipment are stored or parked at an approved location, that they are properly stowed to prevent foreign object debris (FOD), attraction by wildlife, or obstruction of air

operations either by their proximity to NAVAIDs or to aircraft movement areas.

**TCI-3.4 FOREIGN OBJECT DEBRIS (FOD) MANAGEMENT.** Waste and loose materials capable of causing damage to aircraft landing gear or propellers or capable of being ingested in jet engines should not be left or placed on or near active aircraft movement areas. Materials tracked onto these areas shall be continuously removed by the Contractor during the construction project. Waste or loose materials that could attract wildlife shall be carefully controlled and removed on a continuous basis. The Contractor shall have sufficient mechanized sweepers and covered trash containers on site to comply with this requirement at all times. The construction area shall be kept clean at all times of debris that may blow onto the airfield.

**TCI-3.6 FLAGGERS, GATE KEEPERS AND ESCORTS.** Flaggers, gate keepers and escorts shall be provided, as necessary, to control the Contractor's traffic during the prosecution of the work. All Contractor vehicles or equipment that are required to cross or travel along active taxilanes shall do so under the direct control or direction of competent contractor personnel.

**TCI-3.7 TEMPORARY DRAINAGE.** Temporary drainage items shall be provided and installed in accordance with the plans and/or as needed to meet project phasing, drainage, and erosion and sediment control requirements. Drainage measures shall be placed in a manner that will provide for maintenance of existing drainage patterns to the maximum extent possible. Construction methods for installation shall be in accordance with Specification Section D-701, Pipe for Storm Drains and Culverts, and Specification Section D-752, Concrete Culverts, Headwalls, and Miscellaneous Drainage Structures.

#### **METHOD OF MEASUREMENT**

**TCI-4.1** No direct measurement will be made for temporary construction items as payment will be made on a lump sum basis.

**TCI-4.2** No direct measurement will be made for optional temporary haul roads, with all costs included in this item.

**TCI-4.3** No direct measurement will be made for flaggers, gate keepers and escorts as costs shall be included in the lump sum price as part of Item 105 "Mobilization".

**TCI-4.4** No direct measurement will be made for portable lighting as payment shall be considered incidental to the item requiring it.

**TCI-4.5** No direct measurement will be made for temporary drainage as payment shall be considered incidental to the item requiring it.

## **BASIS OF PAYMENT**

**TCI-5.1**     **TEMPORARY CONSTRUCTION ITEMS.** Payment will be made at the lump sum bid price for “Temporary Construction Items.” This payment shall be full compensation for furnishing all materials and labor for placing, moving, maintaining, and removing construction barricades and taxiway closure crosses. This pay item also includes preparation of optional temporary haul roads, foreign object debris (FOD) management, maintenance of construction access and haul routes along and across taxilanes and/or optional haul roads throughout construction, and restoration of these areas to their original condition at the conclusion of construction. All labor, materials, equipment, tools, and incidentals necessary to complete this item shall be included in this lump sum cost.

**TEMPORARY HAUL ROUTE.** No separate payment will be for construction, maintenance and restoration of the optional temporary haul road. If implemented at the Contractor’s option, the temporary haul road area shall be seeded and stabilized using excelsior matting following removal, excluding the sections of the haul route that connects to the taxiways/taxilanes which shall be sodded in accordance with T-904. The sections to be sodded are 20’ offset from the edge of existing taxiway/taxilane pavement X the Width of the temporary haul route). The 3” of Topsoil (from Off-Site) required for this restoration shall also be considered incidental to the lump sum price for Temporary Construction Items.

### **TEMPORARY CONSTRUCTION ITEMS – Payment Schedule**

Payment for this item will be made in installments. The first payment of 40 percent of the lump sum price will be included in the payment application following commencement of work. The remaining 60 percent of the lump sum price will be included as installments in subsequent pay requests at a rate of 10 percent per pay request. Any remaining portion of the lump sum price will be paid as part of the final pay request.

Payment will be made under:

Item TCI-5.1.1    Temporary Construction Items – per Lump Sum

**END OF ITEM TCI**

**ITEM P-101**

**PREPARATION/REMOVAL OF EXISTING PAVEMENTS AND MISCELLANEOUS ITEMS**

**DESCRIPTION**

- 101-1** This item shall consist of preparation of existing pavement surfaces for overlay, surface treatments, removal of existing pavement, and other miscellaneous items. The work shall be accomplished in accordance with these specifications and the applicable plans.

**EQUIPMENT AND MATERIALS**

- 101-2** All equipment and materials shall be specified here and in the following paragraphs or approved by the ENGINEER. The equipment shall not cause damage to the pavement to remain in place.

**CONSTRUCTION**

- 101-3.1 Removal of Existing Pavement.** The Contractor's removal operation shall be controlled to not damage adjacent pavement structure, and base material, cables, utility ducts, pipelines, or drainage structures which are to remain under the pavement.

**A. Concrete Pavement Removal.** Full depth saw cuts shall be made perpendicular to the slab surface. The Contractor shall saw through the full depth of the slab including any dowels at the joint, removing the pavement and installing new dowels as shown on the plans and per the specifications. Where the perimeter of the removal limits is not located on the joint and there are no dowels present, the perimeter shall be saw cut the full depth of the pavement. The pavement inside the saw cut shall be removed by methods which will not cause distress in the pavement which is to remain in place. Concrete slabs that are damaged by under breaking shall be repaired or removed and replaced as directed by the ENGINEER.

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Spall and underbreak repair shall be in accordance with the plans. Any underlying material that is to remain in place, shall be recompact and/or replaced as shown on the plans. Adjacent areas damaged during repair shall be repaired or replaced at the Contractor's expense.

**B. Asphalt Pavement Removal.** Asphalt pavement to be removed shall be cut to the full depth of the asphalt pavement around the perimeter of the area to be removed.

**C. Repair or Removal of Base, Subbase, and/or Subgrade.** All failed material including surface, base course, subbase course, and subgrade shall be removed and repaired as shown on the plans or as directed by the ENGINEER. Materials and methods of construction shall comply with the applicable sections of these specifications. Any damage caused by Contractor's removal process shall be repaired at the Contractor's expense.

**101-3.2 Preparation of Joints and Cracks Prior to Overlay/Surface Treatment.**  
Not used.

**101-3.3 Removal of Foreign Substances/Contaminates Prior to (Overlay) (Seal-Coat) (Marking)** Not used.

**101-3.4 Concrete Spall or Failed Asphaltic Concrete Pavement Repair.** Not used.

**101-3.5 Cold Milling.** Milling shall be performed with a power-operated milling machine or grinder, capable of producing a uniform finished surface. The milling machine or grinder shall operate without tearing or gouging the underlaying surface. The milling machine or grinder shall be equipped with grade and slope controls, and a positive means of dust control. All millings shall be removed and disposed of off Airport property. If the Contractor mills or grinds deeper or wider than the plans specify, the Contractor shall replace the material removed with new material at the Contractor's Expense.

**A. Patching.** The milling machine shall be capable of cutting a vertical edge without chipping or spalling the edges of the remaining pavement and it shall have a positive method of controlling the depth of cut. The Contractor shall layout the area to be milled with a straightedge in increments of 1-foot widths. The area to be milled shall cover only the failed area. Any excessive area that is milled because the Contractor does not have the appropriate milling machine, or areas that are damaged because of his negligence, shall be repaired by the Contractor at the Contractor's Expense.

**B. Profiling, Grade Correction, or Surface Correction.** The milling machine shall have a minimum width of 7 feet, and it shall be equipped with electronic grade control devices that will cut the surface to the grade specified. The tolerances shall be maintained within +0 inch and -1/4 inch

of the specified grade. The machine must cut vertical edges and have a positive method of dust control. The machine must have the ability to remove the millings or cuttings from the pavement and load them into a truck. All millings shall be removed and disposed of off the Airport.

**C. Clean-Up.** The Contractor shall sweep the milled surface daily and immediately after the milling until all residual materials are removed from the pavement surface. Prior to paving, the Contractor shall wet down the milled pavement and thoroughly sweep and/or blow off the surface to remove loose residual material. Waste materials shall be collected and removed from the pavement surface and adjacent areas by sweeping or vacuuming. Waste materials shall be removed and disposed of off Airport.

**101-3.6. Preparation of Asphalt Pavement Surfaces Prior to Surface Treatment.**

Not used.

**101-3.7 Maintenance.** The Contractor shall perform all maintenance work necessary to keep the pavement in a satisfactory condition until the full section is complete and accepted by the ENGINEER. The surface shall be kept clean and free from foreign material. The pavement shall be properly drained at all times. If cleaning is necessary or if the pavement becomes disturbed, any work repairs necessary shall be performed at the Contractor's expense.

**101-3.8 Preparation of Joints in Rigid Pavement Prior to Resealing.** Not used.

**101-3.9 Preparation of Cracks in Flexible Pavement Prior to Sealing.** Not used.

**101-3.10 Removal of Pipe and other Buried Structures.**

**A. Removal of Existing Pipe Material.** Remove the types of pipe as indicated on the plans. The pipe material shall be legally disposed of off-site in a timely manner following removal. Trenches shall be backfilled with material equal to or better in quality than adjacent embankment. Trenches under paved areas must be compacted to 95% of ASTM D1557.

**B. Removal of Inlets/Manholes and Buried Junction Boxes.** Where indicated on the plans or as directed by the ENGINEER, inlets , manholes and/or buried junction boxes shall be removed and legally disposed of off-site in a timely fashion after removal. Excavations after removal shall be backfilled with material equal or better in quality than adjacent embankment. When under paved areas must be compacted to 95% of ASTM D1557, when outside of paved areas must be compacted to 95% of ASTM D1557.

**C. Removal of Existing Drainage Inlets/Outlets.** Where indicated on the plans or as directed by the ENGINEER, Drainage Inlets/Outlets and associated headwalls and rip rap shall be removed and legally disposed of off-site in a timely fashion after removal. Excavations after removal shall be backfilled with material equal or better in quality than adjacent embankment. When under paved areas must be compacted to 95% of ASTM D1557, when outside of paved areas must be compacted to 95% of ASTM D1557.

### **METHOD OF MEASUREMENT**

- 101-4.1 Pavement Removal.** The unit of measurement for pavement removal shall be the number of square yards removed by the Contractor. Any pavement removed outside the limits of removal because the pavement was damaged by negligence on the part of the Contractor shall not be included in the measurement for payment. No direct measurement or payment shall be made for saw cutting. Saw cutting shall be incidental to pavement removal. Dowel bar installation shall be incidental to pavement removal. Full-depth pavement removal shall include removal of existing aggregate base course. This price shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with Paragraphs 101-3.1 and 101-3.7.
- 101-4.2 Cold Milling.** The unit of measure for cold milling shall be per square yard. The location and average depth of the cold milling shall be as shown on the plans. If the initial cut does not correct the condition, the Contractor shall re-mill the area and will be paid for the total depth of milling. This price shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with Paragraphs 101-3.5 and 101-3.7.
- 101-4.3 Drainage Demolition.** The unit of measurement for drainage demolition shall be lump sum. No separate measurement for payment will be made. The work covered by this section shall be considered as a subsidiary obligation of the Contractor and covered under the other contract items. This price shall be full compensation for all labor, equipment, tools, and incidentals necessary to complete this item in accordance with Paragraph 101-3.10. This pay item shall also be full compensation for all backfill material and placement of such materials necessary to replace these removed materials.



## **BASIS OF PAYMENT**

**101-5.1 Payment.** Payment shall be made at contract unit price for the unit of measurement as specified above. This price shall be full compensation for furnishing all materials and for all preparation, hauling, and placing of the material and for all labor, equipment, tools, and incidentals necessary to complete this item.

Item P-101.5.1 Asphaltic Pavement Removal, Full-Depth – per Square Yard

Item P-101.5.2 Concrete Pavement Removal, Full-Depth – per Square Yard

Item P-101.5.3 Asphaltic Pavement Tie-In Milling, 1.5" Depth – per Square Yard

Item P-101.5.4 Drainage Demolition – per Lump Sum

## **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.

### **Advisory Circulars (AC)**

AC 150/5380-6C Guidelines and Procedures for Maintenance of Airport Pavements.

## **END OF ITEM P-101**

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## ITEM P-152

### EXCAVATION, SUBGRADE, AND EMBANKMENT

#### DESCRIPTION

- 152-1.1** This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct safety areas, runways, taxiways, aprons, and intermediate areas as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical sections shown on the plans.
- 152-1.2 Classification.** All material excavated shall be classified as defined below:
- A. Unclassified Excavation.** Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature which is not otherwise classified and paid for under one of the following items.
  - B. Undercut Excavation.** Undercut excavation shall consist of the removal and disposal of deposits or mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials that will decay or produce subsidence in the embankment. It may consist of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment.
  - C. Borrow Embankment.** Borrow embankment shall consist of approved material required for the construction of embankments or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas designated by the ENGINEER within the limits of the Airport property but outside the normal limits of necessary grading, or from areas outside the Airport boundaries.
- 152-1.3 Unsuitable Excavation.** Unsuitable material shall be disposed in designated waste areas as shown on the plans. Materials containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material suitable for topsoil may be used on the embankment slope when approved by the ENGINEER.

#### CONSTRUCTION METHODS

- 152-2.1 General.** Before beginning excavation, grading, and embankment operations in any area, the area shall be cleared or cleared and grubbed in accordance with Item P-151.

The suitability of material to be placed in embankments shall be subject to approval by the ENGINEER. All unsuitable material shall be disposed of off airport property. All waste areas shall be graded to allow positive drainage of the area and adjacent areas. The surface elevation of waste areas shall be specified on the plans or approved by the ENGINEER.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued and the ENGINEER notified per Section 70, Paragraph 70-20. At the direction of the ENGINEER, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Areas outside the limits of the pavement areas where the top layer of soil has become compacted by hauling or other Contractor activities shall be scarified and disked to a depth of 4 inches, to loosen and pulverize the soil. Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in the top 6 inches of the subgrade.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures, the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the ENGINEER, who shall arrange for their removal if necessary. The Contractor, at their own expense, shall satisfactorily repair or pay the cost of all damage to such facilities or structures that may result from any of the Contractor's operations during the period of the contract.

**A. Blasting.** Blasting shall not be allowed.

**152-2.2 Excavation.** No excavation shall be started until the work has been staked out by the Contractor and the ENGINEER has obtained from the Contractor, the survey notes of the elevations and measurements of the ground surface. The Contractor and ENGINEER shall agree that the original ground lines shown on the original topographic mapping are accurate or agree to any adjustments made to the original ground lines.

Digital terrain model (DTM) files of the existing surfaces finished surfaces and other various surfaces were used to develop the design plans.

Volumetric quantities were calculated by comparing DTM files of the applicable design surfaces and generating Triangle Volume Reports. Electronic copies of DTM files and a paper copy of the original topographic map will be issued to the successful bidder.

Existing grades on the design cross sections or DTM's, where they do not match the locations of actual spot elevations shown on the topographic map, were developed by computer interpolation from those spot elevations. Prior to disturbing original grade, Contractor shall verify the accuracy of the existing ground surface by verifying spot elevations at the same locations where original field survey data was obtained as indicated on the topographic map. Contractor shall recognize that, due to the interpolation process, the actual ground surface at any particular location may differ somewhat from the interpolated surface shown on the design cross sections or obtained from the DTM's. Contractor's verification of original ground surface, however, shall be limited to verification of spot elevations as indicated herein, and no adjustments will be made to the original ground surface unless the Contractor demonstrates that spot elevations shown are incorrect. For this purpose, spot elevations which are within 0.1 foot of the stated elevations for ground surfaces, or within 0.04 foot for hard surfaces (pavements, buildings, foundations, structures, etc.) shall be considered "no change". Only deviations in excess of these will be considered for adjustment of the original ground surface. If Contractor's verification identifies discrepancies in the topographic map, Contractor shall notify the ENGINEER in writing at least two weeks before disturbance of existing grade to allow sufficient time to verify the submitted information and make adjustments to the design cross sections or DTM's. Disturbance of existing grade in any area shall constitute acceptance by the Contractor of the accuracy of the original elevations shown on the topographic map for that area.

All areas to be excavated shall be stripped of vegetation and topsoil. Topsoil shall be stockpiled for future use in areas designated on the plans or by the ENGINEER. All suitable excavated material shall be used in the formation of embankment, subgrade, or other purposes as shown on the plans. All unsuitable material shall be disposed of as shown on the plans.

The grade shall be maintained so that the surface is well drained at all times.

When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed as directed by the ENGINEER. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas.

**A. Selective Grading.** Not used.

**B. Undercutting.** Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for safety areas, subgrades, roads, shoulders, or any areas intended for turf shall be excavated to a minimum depth of 12 inches below the subgrade or to the depth specified by the ENGINEER. Muck, peat, matted roots, or other yielding material, unsatisfactory for

subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of off the Airport. The cost is incidental to this item. This excavated material shall be paid for at the contract unit price per cubic yard for undercut excavation. The excavated area shall be backfilled with suitable material obtained from the grading operations or borrow areas and compacted to specified densities. The necessary backfill will constitute a part of the embankment. Where rock cuts are made, backfill with select material. Any pockets created in the rock surface shall be drained in accordance with the details shown on the plans. Undercutting will be paid as "Undercut Excavation".

**C. Over-Break.** Over-break, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the ENGINEER. All over-break shall be graded or removed by the Contractor and disposed of as directed by the ENGINEER. The ENGINEER shall determine if the displacement of such material was unavoidable and their own decision shall be final. Payment will not be made for the removal and disposal of over-break that the ENGINEER determines as avoidable. Unavoidable over-break will be classified as "Unclassified Excavation."

**D. Removal of Utilities.** The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by someone other than the Contractor as indicated on the plans. All existing foundations shall be excavated at least 2 feet below the top of subgrade or as indicated on the plans, and the material disposed of as directed by the ENGINEER. All foundations thus excavated shall be backfilled with suitable material and compacted as specified for embankment or as shown on the plans.

**152-2.3 Borrow Embankment.** There are no borrow sources within the boundaries of the Airport property. The Contractor shall locate and obtain borrow sources, subject to the approval of the ENGINEER. The Contractor shall notify the ENGINEER at least 15 days prior to beginning the excavation so necessary measurements and tests can be made by the ENGINEER. All borrow pits shall be opened to expose the various strata of acceptable material to allow obtaining a uniform product. Borrow areas shall be drained and left in a neat, presentable condition with all slopes dressed uniformly. Borrow areas shall not create a hazardous wildlife attractant.

**152-2.4 Drainage Excavation.** Drainage excavation shall consist of excavating drainage ditches including intercepting, inlet, or outlet ditches; or other types as shown on the plans. The work shall be performed in sequence with the other construction. Ditches shall be constructed prior to starting adjacent excavation operations. All satisfactory material shall be placed in embankment fills; unsuitable material shall be placed in designated waste areas or as directed by the ENGINEER. All necessary work shall be performed true to final line,

elevation, and cross-section. The Contractor shall maintain ditches constructed on the project to the required cross-section and shall keep them free of debris or obstructions until the project is accepted.

**152-2.5 Preparation of Cut Areas or Areas Where Existing Pavement Has Been Removed.** In those areas on which a subbase or base course is to be placed, the top 12 inches of subgrade shall be compacted to not less than 100 % of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM D1557. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

**152-2.6 Preparation of Embankment Area.** All sod and vegetative matter shall be removed from the surface upon which the embankment is to be placed. The cleared surface shall be broken up by plowing or scarifying to a minimum depth of 6 inches and shall then be compacted per Paragraph 152-2.10.

Sloped surfaces steeper than one (1) vertical to four (4) horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

**152-2.7 Control Strip.** The first half-day of construction of subgrade and/or embankment shall be considered as a control strip for the Contractor to demonstrate, in the presence of the RPR/ENGINEER, that the materials, equipment, and construction processes meet the requirements of this specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR/ENGINEER must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted, or removed and replaced at the Contractor's expense. Full operations shall not begin until the control strip has been accepted by the ENGINEER. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved in advance by the ENGINEER.

**152-2.8 Formation of Embankments.** The material shall be constructed in lifts as established in the control strip, but not less than 6 inches nor more than 12 inches of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications.

The lifts shall be placed, to produce a soil structure as shown on the typical cross-section or as directed by the ENGINEER. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Earthwork operations shall be suspended at any time when satisfactory results cannot be obtained due to rain, freezing, or other unsatisfactory weather conditions in the field. Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. The Contractor shall drag, blade, or slope the embankment to provide surface drainage at all times.

The material in each lift shall be within  $\pm 2\%$  of optimum moisture content before rolling to obtain the prescribed compaction. The material shall be moistened or aerated as necessary to achieve a uniform moisture content throughout the lift. Natural drying may be accelerated by blending in dry material or manipulation alone to increase the rate of evaporation.

The Contractor shall make the necessary corrections and adjustments in methods, materials, or moisture content to achieve the specified embankment density.

The ENGINEER will take samples of excavated materials which will be used in embankment for testing and develop a Moisture-Density Relations of Soils Report (Proctor) in accordance with ASTM D1557. A new Proctor shall be developed for each soil type based on visual classification. Density tests will be taken by the ENGINEER for every 1,000 square yards of compacted embankment for each lift which is required to be compacted, or other appropriate frequencies as determined by the ENGINEER.

If the material has greater than 30% retained on the 3/4-inch sieve, follow AASHTO T-180 Annex Correction of maximum dry density and optimum moisture for oversized particles.



Rolling operations shall be continued until the embankment is compacted to not less than 100% of maximum density for non-cohesive soils, and 95% of maximum density for cohesive soils as determined by ASTM D1557. Under all areas to be paved, the embankments shall be compacted to the requirements of Section 152-2.10. As used in this specification, "non-cohesive" shall mean those soils having a plasticity index (PI) of less than 3 as determined by ASTM D4318.

On all areas outside of the pavement areas, no compaction will be required on the top 4 inches which shall be prepared for a seedbed in accordance with Item T-901.

The in-place field density shall be determined in accordance with ASTM 6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938. The ENGINEER shall perform all density tests for acceptance. If the specified density is not attained, the area represented by the test or as designated by the ENGINEER shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

Compaction areas shall be kept separate, and no lift shall be covered by another lift until the proper density is obtained.

During construction of the embankment, the Contractor shall route all construction equipment evenly over the entire width of the embankment as each lift is placed. Lift placement shall begin in the deepest portion of the embankment fill. As placement progresses, the lifts shall be constructed approximately parallel to the finished pavement grade line.

When rock, concrete pavement, asphalt pavement, and other embankment material are excavated at approximately the same time as the subgrade, the material shall be incorporated into the outer portion of the embankment and the subgrade material shall be incorporated under the future paved areas. Stones, fragmentary rock, and recycled pavement larger than 4 inches in their greatest dimensions will not be allowed in the top 12 inches of the subgrade. Rockfill shall be brought up in lifts as specified or as directed by the ENGINEER and the finer material shall be used to fill the voids forming a dense, compact mass. Rock, cement concrete pavement, asphalt pavement, and other embankment material shall not be disposed of except at places and in the manner designated on the plans or by the ENGINEER.

When the excavated material consists predominantly of rock fragments of such size that the material cannot be placed in lifts of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in lifts not exceeding 2 feet in

thickness. Each lift shall be leveled and smoothed with suitable equipment by distribution of spalls and finer fragments of rock. The lift shall not be constructed above an elevation 4 feet below the finished subgrade.

There will be no separate measurement of payment for compacted embankment. All costs incidental to placing in lifts, compacting, discing, watering, mixing, sloping, and other operations necessary for construction of embankments will be included in the contract price for excavation, borrow, or other items.

**152-2.9 Proof Rolling.** The purpose of proof rolling the subgrade is to identify any weak areas in the subgrade and not for compaction of the subgrade. Before start of embankment, and after compaction is completed, the subgrade area shall be proof rolled with a 20 ton Tandem axle Dual Wheel Dump Truck loaded to the legal limit with tires inflated to 80/100/150 psi in the presence of the RPR/ENGINEER. Apply a minimum of two coverages, or as specified by the ENGINEER, under pavement areas. A coverage is defined as the application of one tire print over the designated area. Soft areas of subgrade that deflect more than 1 inch or show permanent deformation greater than 1 inch shall be removed and replaced with suitable material or reworked to conform to the moisture content and compaction requirements in accordance with these specifications. Removal and replacement of soft areas is incidental to this item.

**152-2.10 Compaction Requirements.** The subgrade under areas to be paved shall be compacted to the requirements shown in the tables below as determined by ASTM D1557. The subgrade in areas outside the limits of the pavement areas shall be compacted to a depth of 12 inches and to a density of not less than 95 percent of the maximum density.

Non-cohesive Soils

Percent Maximum Dry Density (%)	Depth of Compaction from Pavement Surface (in)
100	0 - 16
95	16 - 23
90	23 - 36
85	36 - 50

Cohesive Soils

Percent Maximum Dry Density (%)	Depth of Compaction from Pavement Surface (in)
95	0 - 16
90	16 - 19
85	19 - 27
80	27 - 35

The material to be compacted shall be within  $\pm 2\%$  of optimum moisture content before being rolled to obtain the prescribed compaction (except for expansive soils). When the material has greater than 30 percent retained on the  $\frac{3}{4}$  inch sieve, follow the methods in ASTM D1557. Tests for moisture content and compaction will be taken at a minimum of 1,000 S.Y. of subgrade. All quality assurance testing shall be done by the ENGINEER for acceptance determination.

The in-place field density shall be determined in accordance with ASTM D1556 or ASTM D6938 using Procedure A, the direct transmission method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938 within 12 months prior to its use on this contract. The gage shall be field standardized daily.

Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

If the specified density is not attained, the entire lot shall be reworked and/or re-compacted and additional random tests made. This procedure shall be followed until the specified density is reached.

All cut-and-fill slopes shall be uniformly dressed to the slope, cross-section, and alignment shown on the plans or as directed by the ENGINEER and the finished subgrade shall be maintained.

**152-2.11 Finishing and Protection of Subgrade.** Finishing and protection of the subgrade is incidental to this item. Grading and compacting of the subgrade shall be performed so that it will drain readily. All low areas, holes or depressions in the subgrade shall be brought to grade. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans. All ruts or rough places that develop in the completed subgrade shall be graded, re-compacted, and retested. The Contractor shall protect the subgrade from damage and limit hauling over the finished subgrade to only traffic essential for construction purposes.

The Contractor shall maintain the completed course in satisfactory condition throughout placement of subsequent layers. No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been accepted by the ENGINEER.

**152-2.12 Haul.** All hauling will be considered a necessary and incidental part of the work. The Contractor shall include the cost in the contract unit price for the pay of items of work involved. No payment will be made separately or directly for hauling on any part of the work.

The Contractor's equipment shall not cause damage to any excavated surface, compacted lift or to the subgrade as a result of hauling operations. Any damage caused as a result of the Contractor's hauling operations shall be repaired at the Contractor's expense.

The Contractor shall be responsible for providing, maintaining, and removing any haul roads or routes within or outside of the work area, and shall return the affected areas to their former condition, unless otherwise authorized in writing by the Owner. No separate payment will be made for any work or materials associated with providing, maintaining, and removing haul roads or routes.

**152-2.13 Surface Tolerances.** In those areas on which a subbase or base course is to be placed, the surface shall be tested for smoothness and accuracy of grade and crown. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches, reshaped and re-compacted to grade until the required smoothness and accuracy are provided to and approved by the ENGINEER. The Contractor shall perform all final smoothness and grade checks in the presence of the RPR/ENGINEER. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense.

**A. Smoothness.** The finished surface shall not vary more than  $\pm \frac{1}{2}$  inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

**B. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within  $\pm 0.05$  feet of the specified grade.

On safety areas, turfed areas, and other designated areas within the grading limits where no subbase or base is to be placed, grade shall not vary more than 0.10 feet from specified grade. Any deviation in excess of this amount shall be corrected by loosening, adding, or removing materials, and reshaping.

**152-2.14 Topsoil.** When topsoil is specified or required as shown on the plans or under Item T-905, it shall be salvaged from stripping or other grading operations. The topsoil shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its final section of finished construction, the material shall be stockpiled at approved locations. Stockpiles shall be located as shown on the plans and the approved CSPP and shall not be placed on areas that subsequently will require any excavation or embankment fill. If, in the judgment of the ENGINEER, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further re-handling.

Upon completion of grading operations, stockpiled topsoil shall be handled and placed as shown on the plans and as required in Item T-905. Topsoil shall be paid for as provided in Item T-905. No direct payment will be made for topsoil under Item P-152.

### **METHOD OF MEASUREMENT**

- 152-3.1** Measurement for payment specified by the cubic yard shall be computed by the comparison of digital terrain model (DTM) surfaces for computation of neat line design quantities. The end area is that bound by the original ground line established by field cross-sections and the final theoretical pay line established by cross-sections shown on the plans, subject to verification by the ENGINEER.
- 152-3.2** The quantity of unclassified excavation to be paid for shall be the number of cubic yards measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.
- 152-3.3** The quantity of borrow embankment in place shall be the number of cubic yards measured in its final position.
- 152-3.4** The quantity of undercut excavation to be paid for shall be the number of cubic yards measured in its original position. Measurement shall not include the quantity of materials excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed. Material used to backfill undercut areas shall not be measured separately and shall be considered incidental to undercut excavation.

### **BASIS OF PAYMENT**

- 152-4.1** Unclassified Excavation payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.
- 152-4.2** Borrow Embankment payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.
- 152-4.3** Undercut excavation payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-152.4.1

Unclassified Excavation – per Cubic Yard

Item P-152.4.2                      Borrow Embankment – per Cubic Yard

Item P-152.4.3                      Undercut Excavation – per Cubic Yard

## **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.

### **American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO T-180                      Standard Method of Test for Moisture-Density Relations of Soils Using a 10-lb Rammer and a 18-in. Drop

### **ASTM International (ASTM)**

ASTM D1556                      Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D1557                      Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> )

ASTM D6938                      Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

### **Advisory Circulars (AC)**

AC 150/5370-2G                      Operational Safety on Airports During Construction Software

### **Software**

### **FAARFIELD – FAA Rigid and Flexible Iterative Elastic Layered Design**

### **U.S. Department of Transportation**

FAA RD-76-66                      Design and Construction of Airport Pavements on Expansive Soils

## **END OF ITEM P-152**

**ITEM P-209****CRUSHED AGGREGATE BASE COURSE****DESCRIPTION**

**209-1.1** This item consists of a base course composed of crushed aggregate base constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross-sections shown on the plans.

**MATERIALS**

**209-2.1 Crushed Aggregate Base.** Crushed aggregate shall consist of clean, sound, durable particles of crushed stone, crushed gravel, and shall be free from coatings of clay, silt, organic material, clay lumps or balls or other deleterious materials or coatings. The method used to produce the crushed gravel shall result in the fractured particles in the finished product as consistent and uniform as practicable. Fine aggregate portion, defined as the portion passing the No. 4 sieve shall consist of fines from the coarse aggregate crushing operation. The fine aggregate shall be produced by crushing stone, gravel that meet the coarse aggregate requirements for wear and soundness. Aggregate base material requirements are listed in the following table.

**Crushed Aggregate Base Material Requirements**

<b>Material Test</b>	<b>Requirement</b>	<b>Standard</b>
<b>Coarse Aggregate</b>		
Resistance to Degradation	Loss: 45% Maximum	ASTM C131
Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate	Loss After 5 Cycles: 12% Maximum Using Sodium Sulfate - or - 18% Maximum Using Magnesium Sulfate	ASTM C88
Percentage of Fractured Particles	Minimum 90% by Weight of Particles With at Least Two Fractured Faces and 98% With at Least One Fractured Face <sup>1</sup>	ASTM D5821
Flat Particles, Elongated Particles, or Flat and Elongated Particles	10% Maximum, by Weight, of Flat, Elongated, or Flat and Elongated Particles <sup>2</sup>	ASTM D4791
Clay Lumps and Friable Particles	Less Than or Equal to 3 Percent	ASTM C142

Material Test	Requirement	Standard
<b>Fine Aggregate</b>		
Liquid Limit	Less Than or Equal to 25	ASTM D4318
Plasticity Index	Not More than Five (5)	ASTM D4318

- <sup>1</sup> The area of each face shall be equal to at least 75% of the smallest mid-sectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces.
- <sup>2</sup> A flat particle is one having a ratio of width to thickness greater than five (5); an elongated particle is one having a ratio of length to width greater than five (5).

**209-2.2 Gradation Requirements.** The gradation of the aggregate base material shall meet the requirements of the gradation given in the following table when tested per ASTM C117 and ASTM C136. The gradation shall be well graded from coarse to fine and shall not vary from the lower limit on one sieve to the high limit on an adjacent sieve or vice versa.

#### Gradation of Aggregate Base

Sieve Size	Design Range Percentage by Weight passing	Contractor's Final Gradation	Job Control Grading Band Tolerances <sup>1</sup> (Percent)
2 inch	100		0
1-1/2 inch	95-100		±5
1 inch	70-95		±8
3/4 inch	55-85		±8
No. 4	30-60		±8
No. 40 <sup>2</sup>	10-30		±5
No. 200 <sup>2</sup>	0-10		±3

<sup>1</sup> The "Job Control Grading Band Tolerances for Contractor's Final Gradation" in the table shall be applied to "Contractor's Final Gradation" to establish a job control grading band. The full tolerance still applies if application of the tolerances results in a job control grading band outside the design range.



<sup>2</sup> The fraction of material passing the No 200 sieve shall not exceed two-thirds the fraction passing the No 40 sieve.

### **209-2.3 Sampling and Testing.**

**A. Aggregate Base Materials.** The Contractor shall take samples of the aggregate base in accordance with ASTM D75 to verify initial aggregate base requirements and gradation. Material shall meet the requirements in Paragraph 209-2.1. This sampling and testing will be the basis for approval of the aggregate base quality requirements.

**B. Gradation Requirements.** The Contractor shall take at least two aggregate base samples per day in the presence of the RPR/ENGINEER and complete gradation testing to check the final gradation. Sampling shall be per ASTM D75 and gradation testing shall per ASTM C117 and ASTM C136. Material shall meet the requirements in Paragraph 209-2.2. The samples shall be taken from the in-place, un-compacted material at sampling points and intervals designated by the ENGINEER.

### **209-2.4 Separation Geotextile.** Not used.

## **CONSTRUCTION METHODS**

**209-3.1 Control Strip.** The first half-day of construction shall be considered the control strip. The Contractor shall demonstrate, in the presence of the RPR/ENGINEER, that the materials, equipment, and construction processes meet the requirements of the specification. The sequence and manner of rolling necessary to obtain specified density requirements shall be determined. The maximum compacted thickness may be increased to a maximum of 12 inches upon the Contractor's demonstration that approved equipment and operations will uniformly compact the lift to the specified density. The RPR/ENGINEER must witness this demonstration and approve the lift thickness prior to full production.

Control strips that do not meet specification requirements shall be reworked, re-compacted or removed and replaced at the Contractor's expense. Full operations shall not continue until the control strip has been accepted by the ENGINEER. The Contractor shall use the same equipment, materials, and construction methods for the remainder of construction, unless adjustments made by the Contractor are approved by the ENGINEER.

**209-3.2 Preparing Underlying Subgrade and/or Subbase.** The underlying subgrade and/or subbase shall be checked and accepted by the ENGINEER before base course placing and spreading operations begin. Re-proof rolling of the subgrade or proof rolling of the subbase in accordance with Item P-152, at the

Contractor's expense, may be required by the ENGINEER if the Contractor fails to ensure proper drainage or protect the subgrade and/or subbase. Any ruts or soft, yielding areas due to improper drainage conditions, hauling, or any other cause, shall be corrected before the base course is placed. To ensure proper drainage, the spreading of the base shall begin along the centerline of the pavement on a crowned section or on the high side of the pavement with a one-way slope.

**209-3.3 Production.** The aggregate shall be uniformly blended and, when at a satisfactory moisture content per Paragraph 209-3.5, the approved material may be transported directly to the placement.

**209-3.4 Placement.** The aggregate shall be placed and spread on the prepared underlying layer by spreader boxes or other devices as approved by the ENGINEER, to a uniform thickness and width. The equipment shall have positive thickness controls to minimize the need for additional manipulation of the material. Dumping from vehicles that require re-handling shall not be permitted. Hauling over the uncompacted base course shall not be permitted.

The aggregate shall meet gradation and moisture requirements prior to compaction. The base course shall be constructed in lifts as established in the control strip, but not less than 4 inches nor more than 12 inches of compacted thickness.

When more than one lift is required to establish the layer thickness shown on the plans, the construction procedure described here shall apply to each lift. No lift shall be covered by subsequent lifts until tests verify that compaction requirements have been met. The Contractor shall rework, re-compact and retest any material placed which does not meet the specifications at the Contractor's expense.

**209-3.5 Compaction.** Immediately after completion of the spreading operations, compact each layer of the base course, as specified, with approved compaction equipment. The number, type, and weight of rollers shall be sufficient to compact the material to the required density within the same day that the aggregate is placed on the subgrade.

The field density of each compacted lift of material shall be at least 100% of the maximum density of laboratory specimens prepared from samples of the base material delivered to the jobsite. The laboratory specimens shall be compacted and tested in accordance with ASTM D1557. The moisture content of the material during placing operations shall be within  $\pm 2$  percentage points of the optimum moisture content as determined by ASTM D1557. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

**209-3.6 Weather Limitations.** Material shall not be placed unless the ambient air temperature is at least 40°F and rising. Work on base course shall not be conducted when the subgrade or subbase is wet or frozen or the base material contains frozen material.

**209-3.7 Maintenance.** The base course shall be maintained in a condition that will meet all specification requirements. When material has been exposed to excessive rain, snow, or freeze-thaw conditions, prior to placement of additional material, the Contractor shall verify that materials still meet all specification requirements. Equipment may be routed over completed sections of base course, provided that no damage results and the equipment is routed over the full width of the completed base course. Any damage resulting to the base course from routing equipment over the base course shall be repaired by the Contractor at the Contractor's expense.

**209-3.8 Surface Tolerances.** After the course has been compacted, the surface shall be tested for smoothness and accuracy of grade and crown by the Contractor. The Contractor shall perform all final smoothness and grade checks in the presence of the RPR/ENGINEER. Any portion lacking the required smoothness or failing in accuracy of grade or crown shall be scarified to a depth of at least 3 inches, reshaped and recompact to grade until the required smoothness and accuracy are provided to and approved by the ENGINEER. Any deviation in surface tolerances shall be corrected by the Contractor at the Contractor's expense. The smoothness and accuracy requirements specified here apply only to the top layer when base course is constructed in more than one layer.

**A. Smoothness.** The finished surface shall not vary more than 3/8-inch when tested with a 12-foot straightedge applied parallel with and at right angles to the centerline. The straightedge shall be moved continuously forward at half the length of the 12-foot straightedge for the full length of each line on a 50-foot grid.

**B. Grade.** The grade and crown shall be measured on a 50-foot grid and shall be within +0 and -1/2 inch of the specified grade.

**209-3.9 Acceptance Sampling and Testing.** Crushed aggregate base course shall be accepted for density and thickness on an area basis. Two tests shall be made for density and thickness for each 1200 square yards. Sampling locations will be determined on a random basis per ASTM D3665.

**A. Density.** The ENGINEER shall perform all density tests for acceptance.

Each area shall be accepted for density when the field density is at least 100% of the maximum density of laboratory specimens compacted and tested per ASTM 1557. The in-place field density shall be determined per ASTM D1556 or ASTM D6938 using Procedure A, the direct transmission

method, and ASTM D6938 shall be used to determine the moisture content of the material. The machine shall be calibrated in accordance with ASTM D6938.. If the specified density is not attained, the area represented by the failed test must be reworked and/or recompact and two additional random tests made. This procedure shall be followed until the specified density is reached. Maximum density refers to maximum dry density at optimum moisture content unless otherwise specified.

**B. Thickness.** Depth tests shall be made by test holes at least 3 inches in diameter that extend through the base. The thickness of the base course shall be within +0 and -1/2 inch of the specified thickness as determined by depth tests taken by the Contractor in the presence of the RPR/ENGINEER for each area. Where the thickness is deficient by more than 1/2-inch, the Contractor shall correct such areas at no additional cost by scarifying to a depth of at least 3 inches, adding new material of proper gradation, and the material shall be blended and recompact to grade. The Contractor shall replace, at his expense, base material where depth tests have been taken.

### **METHOD OF MEASUREMENT**

**209-4.1** The quantity of crushed aggregate base course will be determined by measurement of the number of cubic yards of material actually constructed and accepted by the ENGINEER as complying with the plans and specifications. Base materials shall not be included in any other excavation quantities.

### **BASIS OF PAYMENT**

**209-5.1** Payment shall be made at the contract unit price per cubic yard for crushed aggregate base course. This price shall be full compensation for furnishing all materials, for preparing and placing these materials, and for all labor, equipment tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-209.5.1 Crushed Aggregate Base Course – per Cubic Yard

### **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 C29	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
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ASTM C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Standard Test Method for Materials Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM D75	Standard Practice for Sampling Aggregates
ASTM D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft <sup>3</sup> (600 kN-m/m <sup>3</sup> ))
ASTM D1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D3665	Standard Practice for Random Sampling of Construction Materials
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4491	Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4791	Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D5821	Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

Talbert & Bright

**American Association of State Highway and Transportation Officials  
(AASHTO)**

**END OF ITEM P-209**

## ITEM PMBP

### PLANT MIX BITUMINOUS PAVEMENTS

#### DESCRIPTION

- 1.1** This item shall consist of a surface course composed of mineral aggregate and bituminous material mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross sections shown on the plans. Each course shall be constructed to the depth, typical section, or elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course. All materials, mix design requirements, production methods, construction methods, and acceptance testing shall be in accordance with Section 610 "Asphalt Concrete Plant Mix Pavements" of the NCDOT Standard Specifications for Roads and Structures (January 2024) unless otherwise modified by this specification.

#### MATERIALS

- 2.1** **AGGREGATE.** All aggregates, Bituminous Materials, and Filler shall be provided in accordance with NCDOT Standard Specifications Section 610 "Asphalt Concrete Plant Mix Pavements", Paragraph 610-2.

#### COMPOSITION

- 3.1** **COMPOSITION OF MIXTURE.** The bituminous plant mix shall be composed of a mixture of aggregate, filler if required, and bituminous material. The several aggregate fractions shall be sized, uniformly graded, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula.
- 3.2** **JOB MIX FORMULA.** No bituminous mixture for payment shall be produced until a job mix formula has been approved by the ENGINEER. The formula shall be submitted in writing by the Contractor to the ENGINEER at least 15 days prior to the start of paving operations and shall indicate the definite percentage of each sieve fraction of aggregate, the percentage of bitumen, and the temperature of the completed mixture when discharged from the mixer. All test data used to develop the job mix formula shall also be submitted. The job mix formula for each mixture shall be in effect until modified in writing by the ENGINEER. Should a change in sources of materials be made, a new job mix formula must be established before the new material is used.

Reclaimed Asphalt Pavement (RAP) will not be allowed in job mix formula.

The bituminous mixture for the surface course shall meet all of the requirements of the North Carolina Department of Transportation requirements for Superpave

bituminous concrete surface course Type S-9.5B.

- 3.2.1 GRADATION AND JOB MIX FORMULA.** The bituminous concrete aggregate gradation and job mix formula shall meet the requirements of the current North Carolina Department of Transportation Standard Specifications for Superpave Bituminous Concrete Surface Course Type S-9.5B.

### **CONSTRUCTION METHODS**

- 4.1** The Bituminous Concrete Surface Course shall be constructed, in accordance with the North Carolina Department of Transportation Standard Specifications, Section 610. This work shall include plant mixing, hauling, placement, compaction and acceptance testing and all other incidentals required to provide a complete bituminous surface course as required by Section 610 "Asphalt Concrete Plant Mix Pavements" of the NCDOT Standard Specifications for Roads and Structures unless otherwise modified by this specification.
- 4.2 COMPACTION OF MIXTURE.** The Bituminous Concrete Surface shall be compacted to the density requirements in accordance with the North Carolina Department of Transportation Standard Specifications, Sections 610-9 and 610-10.
- 4.3 ACCEPTANCE SAMPLING AND TESTING OF BITUMINOUS MIXTURE (DENSITY).** Density Acceptance shall be in accordance with the North Carolina Department of Transportation Standard Specifications, Section 610-14. Minimum density requirements for all mixes will be as specified in section PMBP 4.2.
- 4.4 SAMPLING PAVEMENT.** Samples for determination of thickness and density of completed pavements shall be obtained by the Contractor at no extra cost. The size, number, and locations of the samples will be as directed by the ENGINEER. Samples shall be neatly cut with a core drill, or other approved equipment. The Contractor shall furnish all tools, labor, and materials for cutting samples and replacing pavement.

All laboratory tests necessary to determine conformance with requirements specified herein will be performed without cost to the Contractor.

Samples shall be removed by the Contractor and delivered by the Contractor to the OWNER'S laboratory technician within four hours after the final rolling operation over the pavement from which the sample was taken, unless the Resident Project Representative authorizes the samples to be delivered the following day. Prior to the cutting of samples, the area of pavement from which the samples will be taken shall be cooled with ice or by other appropriate means so that the removal will not damage the sample. The samples shall be delivered to the laboratory technician in an undamaged condition. If the Resident Project Representative authorizes delivery of a sample the following day, the sample



shall be delivered to the laboratory technician prior to 9:00 a.m. All samples shall be appropriately marked or identified so that the exact location from which the sample was taken can be readily recorded by the laboratory technician. Tolerances cited previously are allowable for the continuation of plant production.

**4.5 CONTRACTOR QUALITY CONTROL TESTING.** The Contractor shall perform all QC tests necessary to control the production and construction processes applicable to these specifications and at frequencies identified in the NCDOT QMS Asphalt Manual. The testing program shall include, but not necessarily be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, and surface smoothness.

- a. Temperatures. Temperatures shall be checked at necessary locations to determine the temperatures of the dryer, the asphalt binder in the storage tank, the asphalt at the plant, and the asphalt at the job site.
- b. In-place density monitoring. The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D2950.

**4.6 SURFACE TESTS.** Tests for conformity with the specified crown and grade shall be made by the Contractor immediately after initial compaction. Any variation shall be corrected by the removal or addition of materials and by continuous rolling.

The finished surface shall not vary more than  $\frac{1}{4}$  inch for the surface course when tested with a sixteen (16') foot straightedge applied parallel with, or at right angles to, the centerline. Prior to beginning paving operations, the Contractor shall provide a sixteen (16') foot straightedge to be used in performing the surface tests.

After the completion of final rolling, the smoothness of the course shall be tested by the Contractor; humps or depressions exceeding the specified tolerances shall be immediately corrected by removing the defective work and replacing with new material, as directed by the ENGINEER. This shall be done at the Contractor's expense. The Contractor shall test the pavement surface in the presence of the Resident Project Representative whenever requested by the Resident Project Representative.

The finished surfaces of bituminous courses shall not vary from the gradeline, elevations, and cross sections shown on the contract drawings by more than one half ( $\frac{1}{2}$ ") inch. The Contractor shall correct pavement areas varying in excess of this amount by paving and replacing the defective work. Skin patching will not

be permitted.

- 4.7 METHOD OF PAYMENT ADJUSTMENT.** A failing lot for density acceptance purposes is defined as a lot for which the average of all test sections, and portions thereof, fails to meet the minimum specification requirement. If additional density sampling and testing, beyond the minimum requirement, is performed and additional test sections are thereby created, then all test results shall be included in the lot average. In addition, any lot or portion of a lot that is obviously unacceptable will be rejected for use in the work.

If the Engineer determines that a given lot mix does not meet the minimum specification requirements, but the work is reasonably acceptable, the lot will be accepted at a reduced pay factor in accordance with the following formula. The reduced pay factor will apply to the mix unit price per ton.

$$PF = 100 - 10(D)^{1.465}$$

Where: PF = Pay Factor (computed to 0.1%)  
D = the deficiency of the lot average density,  
not to exceed 3.0%

Note: Where the deficiency of the lot average density exceeds 3.0%, the Engineer reserves the right to reject the lot. If the lot is determined to be reasonably acceptable, the mix will be paid at 50% payment.

Any density lot not meeting minimum density requirements detailed in section PMBP 4.2 will be evaluated for acceptance by the Engineer. If the lot is determined not to be acceptable, the mix will be removed and replaced with mix meeting and compacted to the requirement of these Specifications.

## **METHOD OF MEASUREMENT**

- 5.1** Plant mix bituminous concrete pavement shall be measured by the number of tons of bituminous mixture used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

There will be no separate payment for asphalt binder. The cost for the asphalt binder shall be included in the per ton unit price for Bituminous Pavement.

## **BASIS OF PAYMENT**

- 6.1** Payment for an accepted bituminous concrete pavement shall be made at the full or adjusted contract unit price per ton. The price shall be full compensation for furnishing all materials, for all preparation, mixing, and placing of these

materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item PMBP-6.1	Bituminous Surface Course, NCDOT Type S-9.5B – per Ton
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### **TESTING REQUIREMENTS**

ASTM C 29	Unit Weight of Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 131	Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
ASTM C 136	Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C 183	Sampling Hydraulic Cement
ASTM D 75	Sampling Aggregates
ASTM D 995	Requirements for Mixing Plants for Hot-Mixed Hot-Laid Bituminous Paving Mixtures
ASTM D 1075	Effect of Water on Cohesion of Compacted Bituminous Mixtures
ASTM D 1188	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2489	Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

ASTM D 3665	Random Sampling of Paving Materials
ASTM D 3666	Inspection and Testing Agencies for Bituminous Paving Materials
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
AASHTO T 30	Mechanical Analysis of Extracted Aggregate
The Asphalt Mix Design Methods for Asphalt Institute's Concrete Manual No. 2 (MS-2).	

#### **MATERIAL REQUIREMENTS**

ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 490	Tar
ASTM D 946	Asphalt Cement for Use in Pavement Construction
ASTM D 3381	Viscosity-Graded Asphalt Cement for Use in Pavement Construction

**END OF ITEM PMBP**

## ITEM P-602

### EMULSIFIED ASPHALT PRIME COAT

#### DESCRIPTION

- 602-1.1** This item shall consist of an application of emulsified asphalt material on the prepared base course in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

#### MATERIALS

- 602-2.1 Emulsified Asphalt Material.** The emulsified asphalt material shall be as specified in ASTM D3628 for use as a prime coat appropriate to local conditions. The Contractor shall provide a copy of the Manufacturer's Certificate of Analysis (COA) for the emulsified asphalt material. The COA shall be provided to and approved by the ENGINEER before the emulsified asphalt material is applied. The furnishing of the COA for the emulsified asphalt material shall not be interpreted as a basis for final acceptance. The Manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

#### CONSTRUCTION METHODS

- 602-3.1 Weather Limitations.** The emulsified asphalt prime coat shall be applied only when the existing surface is dry; the atmospheric temperature is 50°F or above, and the temperature has not been below 35°F for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the ENGINEER.
- 602-3.2 Equipment.** The equipment shall include a self-powered pressure asphalt material distributor and equipment for heating asphalt material.

Provide a distributor with pneumatic tires of such size and number that the load produced on the base surface does not exceed 65.0 psi of tire width to prevent rutting, shoving or otherwise damaging the base, surface or other layers in the pavement structure. Design and equip the distributor to spray the asphalt material in a uniform coverage at the specified temperature, at readily determined and controlled rates from 0.05 to 1.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than  $\pm 5\%$ , and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying asphalt material manually to

areas inaccessible to the distributor. Equip the distributor to circulate and agitate the asphalt material during the heating process. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper.

A power broom and power blower suitable for cleaning the surfaces to which the asphalt coat is to be applied shall be provided.

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the ENGINEER.

**602-3.3 Application of Emulsified Asphalt Material.** Immediately before applying the prime coat, the full width of the surface to be primed shall be swept with a power broom to remove all loose dirt and other objectionable material.

The asphalt emulsion material shall be uniformly applied with an asphalt distributor at the rate of 0.15 to 0.30 gallons per square yard depending on the base course surface texture. The type of asphalt material and application rate shall be approved by the ENGINEER prior to application.

Following application of the emulsified asphalt material and prior to application of the succeeding layer of pavement, allow the asphalt coat to cure and to obtain evaporation of any volatiles or moisture. Maintain the coated surface until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas. Allow the prime coat to cure without being disturbed for a period of at least 48 hours or longer, as may be necessary to attain penetration into the treated course. Furnish and spread sand to effectively blot up and cure excess asphalt material. The Contractor shall remove blotting sand prior to asphalt concrete lay down operations at no additional expense to the Owner. Keep traffic off surfaces freshly treated with asphalt material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

**602-3.4 Trial Application Rates.** The Contractor shall apply a minimum of three lengths of at least 100 feet for the full width of the distributor bar to evaluate the amount of emulsified asphalt material that can be satisfactorily applied with the equipment. Apply three different application rates of emulsified asphalt materials within the application range specified in Paragraph 602-3.3. Other trial applications can be made using various amounts of material as directed by the ENGINEER. The trial application is to demonstrate the equipment can uniformly apply the emulsified asphalt material within the rates specified and determine the application rate for the project.

- 602-3.5 Freight and Waybills.** The Contractor shall submit waybills and delivery tickets during the progress of the work. Before the final estimate is allowed, file with the RPR certified waybills and certified delivery tickets for all emulsified asphalt materials used in the construction of the pavement covered by the contract. Do not remove emulsified asphalt material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

### **METHOD OF MEASUREMENT**

- 602-4.1** The emulsified asphalt material for prime coat shall be measured by the gallon. Volume shall be corrected to the volume at 60°F in accordance with ASTM D4311. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of emulsified asphalt material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the emulsified asphalt material is necessary. Water added to emulsified asphalt will not be measured for payment.

### **BASIS OF PAYMENT**

- 602-5.1** Payment shall be made at the contract unit price per gallon for emulsified asphalt prime coat. This price shall be full compensation for furnishing all materials and for all preparation, delivering, and applying the materials, and for all labor, equipment, tools, and incidentals necessary to complete this item.

Payment will be made under:

Item P-602-5.1 Emulsified Asphalt Prime Coat – per Gallon

### **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 D2995 | Standard Practice for Estimating Application Rate and Residual Application Rate of Bituminous Distributors |
| ASTM D3628 | Standard Practice for Selection and Use of Emulsified Asphalts   |

### **END OF ITEM P-602**

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## ITEM P-603

### EMULSIFIED ASPHALT TACK COAT

#### DESCRIPTION

- 603-1.1** This item shall consist of preparing and treating an asphalt or concrete surface with asphalt material in accordance with these specifications and in reasonably close conformity to the lines shown on the plans.

#### MATERIALS

- 603-2.1 Asphalt Materials.** The asphalt material shall be an emulsified asphalt as specified in ASTM D3628 as an asphalt application for tack coat appropriate to local conditions. The emulsified asphalt shall not be diluted. The Contractor shall provide a copy of the Manufacturer's Certificate of Analysis (COA) for the asphalt material to the ENGINEER before the asphalt material is applied for review and acceptance. The furnishing of COA for the asphalt material shall not be interpreted as a basis for final acceptance. The Manufacturer's COA may be subject to verification by testing the material delivered for use on the project.

#### CONSTRUCTION METHODS

- 603-3.1 Weather Limitations.** The tack coat shall be applied only when the existing surface is dry, and the atmospheric temperature is 50°F or above; the temperature has not been below 35°F for the 12 hours prior to application; and when the weather is not foggy or rainy. The temperature requirements may be waived when directed by the ENGINEER.
- 603-3.2 Equipment.** The Contractor shall provide equipment for heating and applying the emulsified asphalt material. The emulsion shall be applied with a Manufacturer-approved computer rate-controlled asphalt distributor. The equipment shall be in good working order and contain no contaminants or diluents in the tank. Spray bar tips must be clean, free of burrs, and of a size to maintain an even distribution of the emulsion. Any type of tip or pressure source is suitable that will maintain predetermined flow rates and constant pressure during the application process with application speeds under eight (8) miles per hour or seven hundred (700) feet per minute.

The equipment will be tested under pressure for leaks and to ensure proper set-up before use to verify truck set-up (via a test-shot area), including but not limited to, nozzle tip size appropriate for application, spray-bar height and pressure and pump speed, evidence of triple-overlap spray pattern, lack of leaks, and any other factors relevant to ensure the truck is in good working order before use.

The distributor truck shall be equipped with a minimum 12-foot spreader spray bar with individual nozzle control with computer-controlled application rates. The distributor truck shall have an easily accessible thermometer that constantly monitors the temperature of the emulsion, and have an operable mechanical tank gauge that can be used to cross-check the computer accuracy. If the distributor is not equipped with an operable quick shutoff valve, the prime operations shall be started and stopped on building paper.

The distributor truck shall be equipped to effectively heat and mix the material to the required temperature prior to application as required. Heating and mixing shall be done in accordance with the Manufacturer's recommendations. Do not overheat or over mix the material.

The distributor shall be equipped with a hand sprayer.

Asphalt distributors must be calibrated annually in accordance with ASTM D2995. The Contractor must furnish a current calibration certification for the asphalt distributor truck from any State or other agency as approved by the ENGINEER.

A power broom and/or power blower suitable for cleaning the surfaces to which the asphalt tack coat is to be applied shall be provided.

**603-3.3 Application of Emulsified Asphalt Material.** The emulsified asphalt shall not be diluted. Immediately before applying the emulsified asphalt tack coat, the full width of surface to be treated shall be swept with a power broom and/or power blower to remove all loose dirt and other objectionable material.

The emulsified asphalt material shall be uniformly applied with an asphalt distributor at the rates appropriate for the conditions and surface specified in the table below. The type of asphalt material and application rate shall be approved by the ENGINEER prior to application.

Emulsified Asphalt		
Surface Type	Residual Rate, gal/SY	Emulsion Application Bar Rate, gal/SY
New Asphalt	0.02-0.05	0.03-0.07
Existing Asphalt	0.04-0.07	0.06-0.11
Milled Surface	0.04-0.08	0.06-0.12
Concrete	0.03-0.05	0.05-0.08

After application of the tack coat, the surface shall be allowed to cure without being disturbed for the period of time necessary to permit drying and setting of the tack coat. This period shall be determined by the ENGINEER. The Contractor shall protect the tack coat and maintain the surface until the next

course has been placed. When the tack coat has been disturbed by the Contractor, tack coat shall be reapplied at the Contractor's expense

- 603-3.4 Freight and Waybills** The Contractor shall submit waybills and delivery tickets, during progress of the work. Before the final statement is allowed, file with the ENGINEER certified waybills and certified delivery tickets for all emulsified asphalt materials used in the construction of the pavement covered by the contract. Do not remove emulsified asphalt material from storage until the initial outage and temperature measurements have been taken. The delivery or storage units will not be released until the final outage has been taken.

### **METHOD OF MEASUREMENT**

- 603-4.1** The emulsified asphalt material for tack coat shall be measured by the gallon. Volume shall be corrected to the volume at 60°F in accordance with ASTM D1250. The emulsified asphalt material paid for will be the measured quantities used in the accepted work, provided that the measured quantities are not 10% over the specified application rate. Any amount of emulsified asphalt material more than 10% over the specified application rate for each application will be deducted from the measured quantities, except for irregular areas where hand spraying of the emulsified asphalt material is necessary. Water added to emulsified asphalt will not be measured for payment.

### **BASIS OF PAYMENT**

- 603.5-1** Payment shall be made at the contract unit price per gallon of emulsified asphalt material. This price shall be full compensation for furnishing all materials, for all preparation, delivery, and application of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-603.5.1 Emulsified Asphalt Tack Coat – per Gallon

### **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 D1250 Standard Guide for Use of the Petroleum Measurement Tables

ASTM D2995 Standard Practice for Estimating Application Rate and  
Residual Application Rate of Bituminous Distributors

ASTM D3628 Standard Practice for Selection and Use of Emulsified  
Asphalts

**END ITEM P-603**

## ITEM P-610

### CONCRETE FOR MISCELLANEOUS STRUCTURES

#### DESCRIPTION

- 610-1.1** This item shall consist of concrete and reinforcement, as shown on the plans, prepared, and constructed in accordance with these specifications. This specification shall be used for all concrete other than airfield pavement which are cast-in-place.

#### MATERIALS

- 610-2.1 General.** Only approved materials, conforming to the requirements of these specifications, shall be used in the work. Materials may be subject to inspection and tests at any time during their preparation or use. The source of all materials shall be approved by the ENGINEER before delivery or use in the work. Representative preliminary samples of the materials shall be submitted by the Contractor, when required, for examination and test. Materials shall be stored and handled to ensure preservation of their quality and fitness for use and shall be located to facilitate prompt inspection. All equipment for handling and transporting materials and concrete must be clean before any material or concrete is placed in them.

The use of pit-run aggregates shall not be permitted unless the pit-run aggregate has been screened and washed, and all fine and coarse aggregates stored separately and kept clean. The mixing of different aggregates from different sources in one storage stockpile or alternating batches of different aggregates shall not be permitted.

- A. Reactivity.** Fine aggregate and coarse aggregates to be used in all concrete shall have been tested separately within six months of the project in accordance with ASTM C1260. Test results shall be submitted to the ENGINEER. The aggregate shall be considered innocuous if the expansion of test specimens, tested in accordance with ASTM C1260, does not exceed 0.08% at 14 days (16 days from casting). If the expansion either or both test specimen is greater than 0.08% at 14 days, but less than 0.20%, a minimum of 25% of Type F fly ash, or between 40% and 55% of slag cement shall be used in the concrete mix.

If the expansion is greater than 0.20%, the aggregates shall not be used, and test results for other aggregates must be submitted for evaluation.

- 610-2.2 Coarse Aggregate.** The coarse aggregate for concrete shall meet the requirements of ASTM C33 and the requirements of Table 4, Class Designation 5S; and the grading requirements shown below, as required for the project.

**Coarse Aggregate Grading Requirements**

<b>Maximum Aggregate Size</b>	<b>ASTM C33, Table 3 Grading Requirements (Size No.)</b>
1 1/2 inch	467 or 4 and 67
1 inch	57
3/4 inch	67
1/2 inch	7

**610-2.2.1 Coarse Aggregate Susceptibility to Durability (D) Cracking.** Coarse aggregate may only be accepted from sources that have a 20-year service history for the same gradation to be supplied with no history of D-Cracking. Aggregates that do not have a 20-year record of service free from major repairs (less than 5% of slabs replaced) in similar conditions without D-cracking shall not be used unless the material currently being produced has a durability factor greater than or equal to 95 per ASTM C666. The Contractor shall submit a current certification and test results to verify the aggregate acceptability. Test results will only be accepted from a State Department of Transportation (DOT) materials laboratory or an accredited laboratory. Certification and test results which are not dated, or which are over one (1) year old or which are for different gradations will not be accepted.

Crushed granite, calcite cemented sandstone, quartzite, basalt, diabase, rhyolite, or trap rock are considered to meet the D-cracking test requirements but must meet all other quality tests specified in Item P-501.

**610-2.3 Fine Aggregate.** The fine aggregate for concrete shall meet all fine aggregate requirements of ASTM C33.

**610-2.4 Cement.** Cement shall conform to the requirements of ASTM C150 Types I or II.

**610-2.5 Cementitious Materials.**

**A. Fly Ash.** Fly ash shall meet the requirements of ASTM C618, with the exception of loss of ignition, where the maximum shall be less than 6%. Fly ash shall have a Calcium Oxide (CaO) content of less than 15% and a total available alkali content less than 3% per ASTM C311. Fly ash produced in furnace operations using liming materials or soda ash (sodium carbonate) as an additive shall not be acceptable. The Contractor shall furnish the previous three most recent, consecutive ASTM C618 reports for each source of fly ash proposed in the concrete mix, and shall furnish each additional report as they become available during the project. The reports

can be used for acceptance or the material may be tested independently by the ENGINEER.

- B. Slag Cement (Ground Granulated Blast Furnace (GGBF)).** Slag cement shall conform to ASTM C989, Grade 100 or Grade 120. Slag cement shall be used only at a rate between 25% and 55% of the total cementitious material by mass.

**610-2.6 Water.** Water used in mixing or curing shall be from potable water sources. Other sources shall be tested in accordance with ASTM C1602 prior to use.

**610-2.7 Admixtures.** The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the ENGINEER may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the ENGINEER from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.

- A. Air-Entraining Admixtures.** Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.

- B. Water-Reducing Admixtures.** Water-reducing admixture shall meet the requirements of ASTM C494, Type A, B, or D. ASTM C494, Type F and G high range water reducing admixtures and ASTM C1017 flowable admixtures shall not be used.

- C. Other Chemical Admixtures.** The use of set retarding, and set-accelerating admixtures shall be approved by the ENGINEER. Retarding shall meet the requirements of ASTM C494, Type A, B, or D and set-accelerating shall meet the requirements of ASTM C494, Type C. Calcium chloride and admixtures containing calcium chloride shall not be used.

**610-2.8 Premolded Joint Material.** Premolded joint material for expansion joints shall meet the requirements of ASTM D1751.

**610-2.9 Joint Filler.** The filler for joints shall meet the requirements of Item P-605, unless otherwise specified.

**610-2.10 Steel Reinforcement.** Reinforcing shall consist of reinforcing steel conforming to the requirements of ASTM A615 or welded steel wire fabric conforming to the requirements of ASTM A1064.

**610-2.11 Materials for Curing Concrete.** Curing materials shall conform to one of the following specifications.

Waterproof paper	ASTM C171
Clear or white Polyethylene Sheeting	ASTM C171
White-pigmented Liquid Membrane-Forming Compound, Type 2, Class B	ASTM C309

### CONSTRUCTION METHODS

**610-3.1 General.** The Contractor shall furnish all labor, materials, and services necessary for, and incidental to, the completion of all work as shown on the drawings and specified here. All machinery and equipment used by the Contractor on the work, shall be of sufficient size to meet the requirements of the work. All work shall be subject to the inspection and approval of the ENGINEER.

**610-3.2 Concrete Mixture.** Cast-in place concrete shall develop a compressive strength of 4000 psi in 28 days as determined by test cylinders made in accordance with ASTM C31 and tested in accordance with ASTM C39. Precast concrete shall develop a compressive strength of 5,000 psi in 28 days. The concrete shall contain not less than 470 pounds of cementitious material per cubic yard. The water cementitious ratio shall not exceed 0.45 by weight. The air content of the concrete shall be 5% +/- 1.2% as determined by ASTM C231 and shall have a slump of not more than 4 inches as determined by ASTM C143.

**610-3.3 Mixing.** Concrete may be mixed at the construction site, at a central point, or wholly or in part in truck mixers. The concrete shall be mixed and delivered in accordance with the requirements of ASTM C94 or ASTM C685.

The concrete shall be mixed only in quantities required for immediate use. Concrete shall not be mixed while the air temperature is below 40°F without the ENGINEER's approval. If approval is granted for mixing under such conditions, aggregates, or water, or both, shall be heated and the concrete shall be placed at a temperature not less than 50°F nor more than 100°F. The Contractor shall be held responsible for any defective work, resulting from freezing or injury in any manner during placing and curing, and shall replace such work at his expense.

Retempering of concrete by adding water or any other material is not permitted.

The rate of delivery of concrete to the job shall be sufficient to allow uninterrupted placement of the concrete.



**610-3.4 Forms.** Concrete shall not be placed until all the forms and reinforcements have been inspected and approved by the ENGINEER. Forms shall be of suitable material and shall be of the type, size, shape, quality, and strength to build the structure as shown on the plans. The forms shall be true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement and sagging between supports. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes. The Contractor shall be responsible for their adequacy.

The internal form ties shall be arranged so no metal will show in the concrete surface or discolor the surface when exposed to weathering when the forms are removed. All forms shall be wetted with water or with a non-staining mineral oil, which shall be applied immediately before the concrete is placed. Forms shall be constructed so they can be removed without injuring the concrete or concrete surface.

**610-3.5 Placing Reinforcement.** All reinforcement shall be accurately placed, as shown on the plans, and shall be firmly held in position during concrete placement. Bars shall be fastened together at intersections. The reinforcement shall be supported by approved metal chairs. Shop drawings, lists, and bending details shall be supplied by the Contractor when required.

**610-3.6 Embedded Items.** Before placing concrete, all embedded items shall be firmly and securely fastened in place as indicated. All embedded items shall be clean and free from coating, rust, scale, oil, or any foreign matter. The concrete shall be spaded and consolidated around and against embedded items. The embedding of wood shall not be allowed.

**610-3.7 Concrete Consistency.** The Contractor shall monitor the consistency of the concrete delivered to the project site; collect each batch ticket; check temperature; and perform slump tests on each truck at the project site in accordance with ASTM C143.

**610-3.8 Placing Concrete.** All concrete shall be placed during daylight hours, unless otherwise approved. The concrete shall not be placed until the depth and condition of foundations, the adequacy of forms and falsework, and the placing of the steel reinforcing have been approved by the ENGINEER. Concrete shall be placed as soon as practical after mixing, but in no case later than one (1) hour after water has been added to the mix. The method and manner of placing shall avoid segregation and displacement of the reinforcement. Troughs, pipes, and chutes shall be used as an aid in placing concrete when necessary. The concrete shall not be dropped from a height of more than 5 feet. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation. Concrete shall be placed on clean, damp surfaces, free from running water, or on a properly consolidated soil foundation.

**610-3.9 Vibration.** Vibration shall follow the guidelines in American Concrete Institute (ACI) Committee 309R, Guide for Consolidation of Concrete.

**610-3.10 Joints.** Joints shall be constructed as indicated on the plans.

**610-3.11 Finishing.** All exposed concrete surfaces shall be true, smooth, and free from open or rough areas, depressions, or projections. All concrete horizontal plane surfaces shall be brought flush to the proper elevation with the finished top surface struck-off with a straightedge and floated.

**610-3.12 Curing and Protection.** All concrete shall be properly cured in accordance with the recommendations in American Concrete Institute (ACI) 308R, Guide to External Curing of Concrete. The concrete shall be protected from damage until project acceptance.

**610-3.13 Cold Weather Placing.** When concrete is placed at temperatures below 40°F, follow the cold weather concreting recommendations found in ACI 306R, Cold Weather Concreting.

**610-3.14 Hot Weather Placing.** When concrete is placed in hot weather greater than 85°F, follow the hot weather concreting recommendations found in ACI 305R, Hot Weather Concreting.

### **QUALITY ASSURANCE (QA)**

**610-4.1 Quality Assurance Sampling and Testing.** Concrete for each day's placement will be accepted on the basis of the compressive strength specified in Paragraph 610-3.2. The ENGINEER will sample the concrete in accordance with ASTM C172; test the slump in accordance with ASTM C143; test air content in accordance with ASTM C231; make and cure compressive strength specimens in accordance with ASTM C31; and test in accordance with ASTM C39. The QA testing agency will meet the requirements of ASTM C1077.

The Contractor shall provide adequate facilities for the initial curing of cylinders.

**610-4.2 Defective Work.** Any defective work that cannot be satisfactorily repaired as determined by the ENGINEER, shall be removed, and replaced at the Contractor's expense. Defective work includes, but is not limited to, uneven dimensions, honeycombing and other voids on the surface or edges of the concrete.

### **METHOD OF MEASUREMENT AND BASIS FOR PAYMENT**

**610-5.1** There will be no direct measurement for payment for any work covered by this item. The cost of any structural concrete used shall be included in the bid item

to which it pertains. These prices shall be full compensation for furnishing all materials and for all preparation, delivery, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

## 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 A184	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A775	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A884	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
ASTM A934	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A1064	Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Standard Specification for Ready-Mixed Concrete

ASTM C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM C114	Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C311	Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
ASTM C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars

ASTM C1017	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1077	Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157	Standard Performance Specification for Hydraulic Cement
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1365	Standard Test Method for Determination of the Proportion of Phases in Portland Cement and Portland-Cement Clinker Using X-Ray Powder Diffraction Analysis
ASTM C1602	Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

**American Concrete Institute (ACI)**

ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 308R	Guide to External Curing of Concrete
ACI 309R	Guide for Consolidation of Concrete

**END OF ITEM P-610**

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**ITEM P-620****RUNWAY AND TAXIWAY MARKING****DESCRIPTION**

- 620-1.1** This item shall consist of the preparation and painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the ENGINEER. The terms “paint” and “marking material” as well as “painting” and “application of markings” are interchangeable throughout this specification.

**MATERIALS**

- 620-2.1 Materials Acceptance.** The Contractor shall furnish Manufacturer’s certified test reports, for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. This certification along with a copy of the paint Manufacturer’s surface preparation; marking materials, including adhesion, flow promoting and/or floatation additive; and application requirements must be submitted and approved by the ENGINEER prior to the initial application of markings. The reports can be used for material acceptance or the ENGINEER may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the ENGINEER upon arrival of a shipment of materials to the site. All material shall arrive in sealed containers that are easily quantifiable for inspection by the ENGINEER.

**620-2.2 Marking Materials.****Table 1. Marking Materials**

<b>Paint<sup>1</sup></b>				<b>Glass Beads<sup>2</sup></b>	
<b>Type</b>	<b>Color</b>	<b>Fed Std. 595 Number</b>	<b>Application Rate Maximum<sup>3</sup></b>	<b>Type</b>	<b>Application Rate Minimum</b>
I or II	Yellow	33538 or 33655	115 ft <sup>2</sup> /gal	III	10 lb/gal
I or II	Black	37038	115 ft <sup>2</sup> /gal	N/A	N/A

<sup>1</sup> See Paragraph 620-2.2A

<sup>2</sup> See Paragraph 620-2.2B

<sup>3</sup> Maximum Application Rate for temporary pavement markings shall be 230 ft<sup>2</sup>/gal

- A. Paint.** Paint shall be waterborne in accordance with the requirements of this paragraph. Paint colors shall comply with Federal Standard No. 595.

Parking lot marking (white and symbols) shall be paint with glass beads (as required) in accordance with NCDOT standards. The lump sum price shall be full compensation for all labor, equipment and materials needed to complete the work.

**Waterborne.** Paint shall meet the requirements of Federal Specification TT-P-1952F, Type I or Type II. The non-volatile portion of the vehicle for all paint types shall be composed of a 100% acrylic polymer as determined by infrared spectral analysis. The acrylic resin used for Type III shall be 100% cross linking acrylic as evidenced by infrared peaks at wavelengths 1568, 1624, and 1672 cm-I with intensities equal to those produced by an acrylic resin known to be 100% cross linking.

- B. Reflective media.** Glass beads for white and yellow paint shall meet the requirements for Federal Specification TT-B-1325D Type III.

Glass beads shall be treated with all compatible coupling agents recommended by the Manufacturers of the paint and reflective media to ensure adhesion and embedment.

Glass beads shall not be used in black and green paint.

Type III glass beads shall not be used in red and pink paint.

## **CONSTRUCTION METHODS**

- 620-3.1 Weather Limitations.** Painting shall only be performed when the surface is dry, and the ambient temperature and the pavement surface temperature meet the Manufacturer's recommendations in accordance with Paragraph 620-2.1. Painting operations shall be discontinued when the ambient or surface temperatures does not meet the Manufacturer's recommendations. Markings shall not be applied when the wind speed exceeds 10 mph unless windscreens are used to shroud the material guns. Markings shall not be applied when weather conditions are forecasts to not be within the Manufacturers' recommendations for application and dry time.
- 620-3.2 Equipment.** Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.



The mechanical marker shall be an atomizing spray-type or airless type marking machine with automatic glass bead dispensers suitable for application of traffic paint. It shall produce an even and uniform film thickness and appearance of both paint and glass beads at the required coverage and shall apply markings of uniform cross-sections and clear-cut edges without running or spattering and without over spray. The marking equipment for both paint and beads shall be calibrated daily.

**620-3.3 Preparation of Surfaces.** Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other contaminants that would reduce the bond between the paint and the pavement. Use of any chemicals or impact abrasives during surface preparation shall be approved in advance by the ENGINEER. After the cleaning operations, sweeping, blowing, or rinsing with pressurized water shall be performed to ensure the surface is clean and free of grit or other debris left from the cleaning process.

**A. Preparation of New Pavement Surfaces.** The area to be painted shall be cleaned by broom, blower, water blasting, or by other methods approved by the ENGINEER to remove all contaminants, including PCC curing compounds, minimizing damage to the pavement surface.

**B. Preparation of Pavement to Remove Existing Markings.** Existing pavement markings shall be removed by waterblasting or other approved, non-destructive methods. The use of chemicals, milling, grinding, sandblasting, and other destructive methods will not be permitted unless otherwise specified. The Contractor shall furnish all equipment, water trucks, and labor for delivery of water to the job site. The Contractor should assume that water required for paint removal will not be available on the airport property.

The removal area may need to be larger than the area of the markings to eliminate ghost markings. After removal of markings on asphalt pavements, apply a fog seal or seal coat to 'block out' the removal area to eliminate 'ghost' markings.

For marking removal occurring during low temperatures, grinding will be acceptable. Contractor shall be responsible for any major damage to pavement due to grinding operations. Major damage shall be considered any damage changing the properties of the pavement or removing more than 1/8" of pavement.

The treatment of the surface shall not be damaging to the bituminous concrete or Portland cement concrete surfaces and joint sealants. If it is deemed by the Engineer that damage to the existing pavement is caused by an operational error, such as permitting pressure water to dwell in one

location for an extensive time, the Contractor shall repair said damage without compensation.

Paint removal shall be identified as the removal of at least 90 percent of the existing marking. The 90 percent removal level is defined such that there will not be any remaining surface of undisturbed paint or individual contiguous areas larger than one square inch where the surface of the pavement material is not clearly exposed.

The method shall not materially damage the structural integrity of the pavement. Any damage caused by the Contractor's operations shall be corrected at the Contractor's expense and in a manner approved by the Engineer. The Contractor shall take precautions to protect the public from any damage due to his operations. Accumulation of sand, water, dust, or other residue resulting from the removal operation shall be removed as the work progresses.

**C. Preparation of Pavement Markings Prior to Remarking.** Prior to remarking existing markings, loose existing markings must be removed minimizing damage to the pavement surface, with a method approved by the ENGINEER. After removal, the surface shall be cleaned of all residue or debris.

Prior to the application of markings, the Contractor shall certify in writing that the surface is dry and free from dirt, grease, oil, laitance, or other foreign material that would prevent the bond of the paint to the pavement or existing markings. This certification along with a copy of the paint manufacturer's application and surface preparation requirements must be submitted to the ENGINEER prior to the initial application of markings.

**620-3.4 Layout of Markings.** The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans.

**620-3.5 Application.** A period of 30 days shall elapse between placement of surface course or seal coat and application of the permanent paint markings. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the ENGINEER.

The edges of the markings shall not vary from a straight line more than 1/2 inch in 50 feet, and marking dimensions and spacing shall be within the following tolerances:

**Marking Dimensions and Spacing Tolerance**

<b>Dimension and Spacing</b>	<b>Tolerance</b>
36 inch or less	±1/2 inch
Greater than 36 inch to 6 feet	±1 inch
Greater than 6 feet to 60 feet	±2 inch
Greater than 60 feet	±3 inch

The paint shall be mixed in accordance with the Manufacturer's instructions and applied to the pavement with a marking machine at the rate shown in Table 1. The addition of thinner will not be permitted.

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished that is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate shown in Table 1. Glass beads shall not be applied to black paint or green paint. Glass beads shall adhere to the cured paint or all marking operations shall cease until corrections are made. Different bead types shall not be mixed. Regular monitoring of glass bead embedment and distribution should be performed.

**620-3.6 Application--Preformed Thermoplastic Airport Pavement Markings.**

Preformed thermoplastic pavement markings not used.

**620-3.7 Control Strip.** Prior to the full application of airfield markings, the Contractor shall prepare a control strip in the presence of the ENGINEER. The Contractor shall demonstrate the surface preparation method and all striping equipment to be used on the project. The marking equipment must achieve the prescribed application rate of paint and population of glass beads (per Table 1) that are properly embedded and evenly distributed across the full width of the marking. Prior to acceptance of the control strip, markings must be evaluated during darkness to ensure a uniform appearance.

**620-3.8 Retro-Reflectance.** Reflectance shall be measured with a portable retro-reflectometer meeting ASTM E1710 (or equivalent). A total of 6 readings shall be taken over a 6 square foot area with 3 readings taken from each direction. The average shall be equal to or above the minimum levels of all readings which are within 30% of each other.

**Minimum Retro-Reflectance Values**

Material	Retro-reflectance mcd/m2/lux		
	White	Yellow	Red
Initial Type I	300	175	35
Initial Type III	600	300	35
Initial Thermoplastic	225	100	35
All Materials, remark when less than <sup>1</sup>	100	75	10

<sup>1</sup> 'Prior to remarking determine if removal of contaminants on markings will restore retro-reflectance

**620-3.9 Protection and Cleanup.** After application of the markings, all markings shall be protected from damage until dry. All surfaces shall be protected from excess moisture and/or rain and from disfiguration by spatter, splashes, spillage, or drippings. The Contractor shall remove from the work area all debris, waste, loose reflective media, and by-products generated by the surface preparation and application operations to the satisfaction of the ENGINEER. The Contractor shall dispose of these wastes in strict compliance with all applicable state, local, and federal environmental statutes, and regulations.

**METHOD OF MEASUREMENT**

**620-4.1a** The quantity of surface preparation shall be measured by the number of square feet of surface preparation specified in Paragraph 620-3.3.

**620-4.1b** The quantity of marking removal shall be measured by the number of square feet of surface preparation and marking removal specified in Paragraph 620-3.3B.

**620-4.1c** The quantity of markings shall be paid for shall be the number of square feet of painting performed in accordance with the specifications and accepted by the Engineer. The First Application and Final Application with Beads and Parking Lot Markings shall be measured separately.

**BASIS OF PAYMENT**

**620-5.1** This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item. Payment shall be made at the respective contract price per square foot for Permanent Pavement Marking and Parking Lot Marking including the cost for reflective media.

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Payment will be made under:

Item P-620.5.1-1	Surface Preparation – per Square Foot
Item P-620.5.1-2	Pavement Marking Removal – per Square Foot
Item P-620.5.1-3	Permanent Pavement Marking (First Application) – per Square Foot
Item P-620.5.1-4	Permanent Pavement Marking (Final Application) – per Square Foot
Item P-620.5.1-5	Parking Lot Marking (White and Symbols) – per Square Foot

### **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 D476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
ASTM D968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D1652	Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D2074	Standard Test Method for Total, Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D7585	Standard Practice for Evaluating Retroreflective Pavement Markings Using Portable Hand-Operated Instruments
ASTM E303	Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

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ASTM E1710	Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2302	Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

**Code of Federal Regulations (CFR)**

40 CFR Part 60	Appendix A-7, Method 24 Determination of volatile matter content, water content, density, volume solids, and weight solids of surface coatings
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**29 CFR Part 1910.1200 Hazard Communication**

**Federal Specifications (FED SPEC)**

FED SPEC TT-B-1325D	Beads (Glass Spheres) Retro-Reflective
FED SPEC TT-P-1952F	Paint, Traffic and Airfield Marking, Waterborne
FED STD 595	Colors used in Government Procurement

**Commercial Item Description**

A-A-2886B	Paint, Traffic, Solvent Based
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**Advisory Circulars (AC)**

AC 150/5340-1M	Standards for Airport Markings
AC 150/5320-12C	Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces

**END OF ITEM P-620**

**ITEM D-701**

**PIPE FOR STORM DRAINS AND CULVERTS**

**DESCRIPTION**

- 701-1.1** This item shall consist of the construction of pipe culverts and storm drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

**MATERIALS**

- 701-2.1** Materials shall meet the requirements shown on the plans and specified below. Underground piping and components used in drainage systems for terminal and aircraft fueling ramp drainage shall be noncombustible and inert to fuel in accordance with National Fire Protection Association (NFPA) 415.

- 701-2.2 Pipe.** The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements:

ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings
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Corrugated PVC pipe shall be capable of meeting H-20 loading requirements with a minimum cover of one foot and shall have a maximum Manning's "n" value of 0.009.

- 701-2.3 Concrete.** Concrete for roof drain splash blocks and reinforced pipe inlet/outlets associated with the corrugated PVC pipe shall conform to the requirements of P-610.

- 701-2.4 Rubber Gaskets.** Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C443. Rubber gaskets for PVC pipe, polyethylene, and polypropylene pipe shall conform to the requirements of ASTM F477

- 701-2.5 Joint Mortar.** Not Used.

- 701-2.6 Joint Fillers.** Not Used.

- 701-2.7 Plastic Gaskets.** Not used.

- 701-2.8. Controlled Low-Strength Material (CLSM).** Not used.

- 701-2.9 Precast Box Culverts.** Not used.

**701-2.10 Precast Concrete Pipe.** Not Used.

**CONSTRUCTION METHODS**

**701-3.1 Excavation.** The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 12 inches on each side. The trench walls shall be approximately vertical.

The Contractor shall comply with all current federal, state, and local rules and regulations governing the safety of men and materials during the excavation, installation, and backfilling operations. Specifically, the Contractor shall observe that all requirements of the Occupational Safety and Health Administration (OSHA) relating to excavations, trenching, and shoring are strictly adhered to. The width of the trench shall be sufficient to permit satisfactory jointing of the pipe and thorough compaction of the bedding material under the pipe and backfill material around the pipe, but it shall not be greater than the widths shown on the plans trench detail.

Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 8 inch or 1/2 inch for each foot of fill over the top of the pipe (whichever is greater) but for no more than three-quarters of the nominal diameter of the pipe. The excavation below grade should be filled with granular material to form a uniform foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The ENGINEER shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

The excavation for pipes placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

**701-3.2 Bedding.** The bedding surface for the pipe shall provide a foundation of uniform density to support the pipe throughout its entire length.

**A. Flexible Pipe.** For flexible pipe, the bed shall be constructed of relatively loose granular material roughly shaped to fit the bottom of the pipe, four to six inches in depth. (ASTM D2321 Class I, II, or other suitable granular material).

**701-3.3 Laying Pipe.** The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the



bedding throughout its full length. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

Elliptical and elliptically reinforced concrete pipes shall be placed with the manufacturer's reference lines designating the top of the pipe within five degrees of a vertical plane through the longitudinal axis of the pipe.

**701-3.4 Joining Pipe.** Joints shall be made with rubber gaskets for corrugated PVC pipe.

**A. PVC Pipe.** Joints for PVC, Polyethylene, or Polypropylene pipe shall conform to the requirements of ASTM D3212. Fittings for PVC pipe shall conform to the requirements of ASTM F949, Section 5.2.3, or ASTM F794, Section 7.2.4.

**701-3.5 Embedment and Overfill.** Pipes shall be inspected before any fill material is placed; any pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense.

#### **701-3.5-1 Embedment Material Requirements**

**A. Plastic and Fiberglass Pipe.** Embedment material shall meet the requirements of ATM D2321 Class I or approved equal compacted to the densities specified in specification Item P-152. Embedment material shall be free of organic material, stones larger than 1.5 inches in the greatest dimension, or frozen lumps. Embedment material shall extend to 12 inches above the top of the pipe.

**701-3.5-2 Placement of Embedment Material.** The embedment material shall be compacted in layers not exceeding 6 inches on each side of the pipe and shall be brought up one foot above the top of the pipe or to natural ground level, whichever is greater. Thoroughly compact the embedment material under the haunches of the pipe without displacing the pipe. Material shall be brought up evenly on each side of the pipe for the full length of the pipe.

When the top of the pipe is above the top of the trench, the embedment material shall be compacted in layers not exceeding 6 inches and shall be brought up evenly on each side of the pipe to one foot above the top of the pipe. All embedment material shall be compacted to a density required under Item P-152.

Concrete cradles and flowable fills, such as controlled low strength material (CLSM) or controlled density fill (CDF), may be used for embedment provided

adequate flotation resistance can be achieved by restraints, weighing, or placement technique.

It shall be the Contractor's responsibility to protect installed pipes and culverts from damage due to construction equipment operations. The Contractor shall be responsible for installation of any extra strutting or backfill required to protect pipes from the construction equipment.

**701-3.6 Overfill.** Pipes shall be inspected before any overfill is in place. Any pipes found to be out of alignment, unduly settled, or damaged shall be removed and re-laid or replaced at the Contractor's expense. Evaluation of any damage to RCP shall be evaluated based on AASHTO R73.

Overfill material shall be placed and compacted in layers as required to achieve compaction to at least 95 percent standard proctor per ASTM D698. The soil shall contain no debris, organic matter, frozen material, or stones with a diameter greater than one half the thickness of the compacted layers being placed.

**701-3.7 Inspection Requirements.** An initial post installation inspection shall be performed by the Contractor no sooner than 30 days after completion of installation and final backfill. Clean or flush all lines prior to inspection. If pipes are flooded, pipes shall be plugged and dewatered to allow for inspection.

Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll, static, or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe.

Any issues reported shall include still photo and video documentation. The zoom ratio shall be provided for all still or video images that document any issues of concern by the inspection firm.

Flexible pipes shall be inspected for rips, tears, joint separations, soil migration, cracks, localized buckling, settlement, alignment, and deflection.

Repair or replace any pipe with cracks exhibiting displacement across the crack, bulges, creases, tears, spalls, or delaminations. The inspection report shall include: a copy of all videos taken, pipe location identification, equipment used for inspection, inspector name, deviation from design line and grade, and inspector's notes. The Post Installation Pipe Inspection Video and Report shall be submitted to the ENGINEER for review and final pipe acceptance.

## **METHOD OF MEASUREMENT**

- 701-4.1** The length of pipe shall be measured in linear feet of pipe in place, completed, and accepted. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. Each type and size of pipe shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.
- 701-4.2.** The Post Installation Pipe Inspection Video and Report will be measured on a lump sum basis.
- 701-4.3** Concrete reinforced pipe inlets/outlets will be measured per each in place, completed, and accepted.
- 701-4.4** Concrete roof drain splash blocks will be measured per each in place, completed, and accepted.

## **BASIS OF PAYMENT**

- 701-5.0** These prices shall fully compensate the Contractor for the furnishing of all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.
- 701-5.1** Payment will be made at the contract unit price per linear foot for each type and size of pipe.
- 701-5.2** Payment for the Post Installation Pipe Inspection Video and Report will be made at the contract lump sum for the completed report. This price shall fully compensate the Contractor for furnishing of all materials and for all preparation and inspection, and for all labor, equipment, tools, and incidentals necessary to complete the item.
- 701-5.3** Payment will be made at the contract unit price per each for concrete reinforced pipe inlets/outlets.
- 701-5.4** Payment will be made at the contract unit price per each for concrete roof drain splash blocks.

Payment will be made under:

- |              |   |
|--------------|---|
| Item 701.5.1 | 15-Inch Corrugated PVC Pipe – per Linear Foot |
| Item 701.5.2 | 18-Inch Corrugated PVC Pipe – per Linear Foot |

Item 701.5.3	24-Inch Corrugated PVC Pipe – per Linear Foot
Item 701.5.4	Post Installation Pipe Inspection Video and Report – per Lump Sum
Item 701.5.5	Concrete Reinforced Pipe Inlet/Outlet – per Each
Item 701.5.6	Concrete Roof Drain Splash Block– per Each

## **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 C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C94	Standard Specification for Ready Mixed Concrete
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C1840	Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F794	Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe & Fittings Based on Controlled Inside Diameter
ASTM F949	Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

**National Fire Protection Association (NFPA)**

NFPA 415	Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways
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**END ITEM D-701**

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**ITEM D-751**

**MANHOLES, CATCH BASINS, INLETS, AND INSPECTION HOLES**

**DESCRIPTION**

- 751-1.1** This item shall consist of construction of manholes, catch basins, inlets, and inspection holes, in accordance with these specifications, at the specified locations and conforming to the lines, grades, and dimensions shown on the plans or required by the ENGINEER.

**MATERIALS**

- 751-2.1 Brick.** Not Used.
- 751-2.2 Mortar.** Mortar shall consist of one part Portland cement and two parts sand. The cement shall conform to the requirements of ASTM C150, Type I. The sand shall conform to the requirements of ASTM C144.
- 751-2.3 Concrete.** Plain and reinforced concrete used in structures, connections of pipes with structures, and the support of structures or frames shall conform to the requirements of Item P-610.
- 751-2.4 Precast Concrete Pipe Manhole Rings.** Precast concrete pipe manhole rings shall conform to the requirements of ASTM C478. Unless otherwise specified, the risers and offset cone sections shall have an inside diameter of not less than 36 inches nor more than 48 inches. There shall be a gasket between individual sections and sections cemented together with mortar on the inside of the manhole. Gaskets shall conform to the requirements of ASTM C443.
- 751-2.5 Corrugated Metal.** Not Used.
- 751-2.6 Frames, Covers, and Grates.** The castings shall conform to one of the following requirements:

**A.** ASTM A536, Grade 65-45-12: Ductile iron castings.

All castings or structural steel units shall conform to the dimensions shown on the plans and shall be designed to support the loadings, aircraft gear configuration and/or direct loading, specified.

Each frame and cover or grate unit shall be provided with fastening members to prevent it from being dislodged by traffic, but which will allow easy removal for access to the structure.

All castings shall be thoroughly cleaned. After fabrication, structural steel units shall be galvanized to meet the requirements of ASTM A123.

**751-2.7 Steps.** The steps or ladder bars shall be gray or malleable cast iron or galvanized steel. The steps shall be the size, length, and shape shown on the plans and those steps that are not galvanized shall be given a coat of asphalt paint, when directed.

**751-2.8 Precast Inlet Structures.** Manufactured in accordance with and conforming to ASTM C913

**751-2.9 PVC Drain Basins.** PVC drain basins shall be Contech A-2000 drain basins or approved equal.

### **CONSTRUCTION METHODS**

#### **751-3.1 Unclassified Excavation.**

**A.** The Contractor shall excavate for structures and footings to the lines and grades or elevations, shown on the plans, or as staked by the Contractor. The excavation shall be of sufficient size to permit the placing of the full width and length of the structure or structure footings shown. The elevations of the bottoms of footings, as shown on the plans, shall be considered as approximately only; and the ENGINEER may direct, in writing, changes in dimensions or elevations of footings necessary for a satisfactory foundation.

**B.** Boulders, logs, or any other objectionable material encountered in excavation shall be removed. All rock or other hard foundation material shall be cleaned of all loose material and cut to a firm surface either level, stepped, or serrated, as directed by the ENGINEER. All seams or crevices shall be cleaned out and grouted. All loose and disintegrated rock and thin strata shall be removed. Where concrete will rest on a surface other than rock, the bottom of the excavation shall not be disturbed and excavation to final grade shall not be made until immediately before the concrete or reinforcing is placed.

**C.** The Contractor shall do all bracing, sheathing, or shoring necessary to implement and protect the excavation and the structure as required for safety or conformance to governing laws. The cost of bracing, sheathing, or shoring shall be included in the unit price bid for the structure.

**D.** All bracing, sheathing, or shoring involved in the construction of this item shall be removed by the Contractor after the completion of the structure. Removal shall not disturb, or damage finished masonry. The cost of removal shall be included in the unit price bid for the structure.



E. After excavation is completed for each structure, the Contractor shall notify the ENGINEER. No concrete or reinforcing steel shall be placed until the ENGINEER has approved the depth of the excavation and the character of the foundation material.

**751-3.2 Brick Structures.** Not Used.

**751-3.3 Cast-In-Place Concrete Structures.** Not Used.

**751-3.4 Precast Concrete Structures.** Precast concrete structures shall be furnished by a plant meeting National Precast Concrete Association Plant Certification Program or American Concrete Pipe Association QCast Plant Certification program.

Precast concrete structures shall conform to ASTM C478. Precast concrete structures shall be constructed on prepared or previously placed slab foundations conforming to the dimensions and locations shown on the plans. All precast concrete sections necessary to build a completed structure shall be furnished. The different sections shall fit together readily. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall: (1) be smoothed to a uniform surface on both interior and exterior of the structure or (2) utilize a rubber gasket per ASTM C443. The top of the upper precast concrete section shall be suitably formed and dimensioned to receive the metal frame and cover or grate, or other cap, as required. Provision shall be made for any connections for lateral pipe, including drops and leads that may be installed in the structure. The flow lines shall be smooth, uniform, and cause minimum resistance to flow. The metal or metal encapsulated steps that are embedded or built into the side walls shall be aligned and placed in accordance with ASTM C478. When a metal ladder replaces the steps, it shall be securely fastened into position.

**751-3.5 Corrugated Metal Structures.** Not Used.

**751-3.6 Inlet and Outlet Pipes.** Inlet and outlet pipes for concrete drop inlets shall extend through the walls of the structures a sufficient distance beyond the outside surface to allow for connections. They shall be cut off flush with the wall on the inside surface of the structure, unless otherwise directed. For concrete or brick structures, mortar shall be placed around these pipes to form a tight, neat connection. Inlet and outlet pipes for PVC drain basins shall be joined to the drain basin with a rubber gasket to ensure a soil tight connection.

**751-3.7 Placement and Treatment of Castings, Frames, And Fittings.** All castings, frames, and fittings shall be placed in the positions indicated on the plans or as directed by the ENGINEER and shall be set true to line and elevation. If frames or fittings are to be set in concrete or cement mortar, all anchors or bolts shall be in place before the concrete or mortar is placed. The unit shall not be

disturbed until the mortar or concrete has set. Frames shall be set flush with adjacent proposed pavement.

After the frames or fittings have been set in final position, the concrete or mortar shall be allowed to harden for seven (7) days before the grates or covers are placed and fastened down.

**751-3.8 Installation of Steps.** The steps shall be installed as indicated on the plans or as directed by the ENGINEER. When the steps are to be set in concrete, they shall be placed and secured in position before the concrete is placed. When the steps are installed in brick masonry, they shall be placed as the masonry is being built. The steps shall not be disturbed or used until the concrete or mortar has hardened for at least seven (7) days. After seven (7) days, the steps shall be cleaned and painted, unless they have been galvanized.

When steps are required with precast concrete structures they shall meet the requirements of ASTM C478. The steps shall be cast into the side of the sections at the time the sections are manufactured or set in place after the structure is erected by drilling holes in the concrete and cementing the steps in place.

Instead of steps, prefabricated ladders may be installed. For brick or concrete structures, the ladder shall be held in place by grouting the supports in drilled holes. For metal structures, the ladder shall be secured by welding the top support to the structure and grouting the bottom support into drilled holes in the foundation or as directed by the ENGINEER.

**751-3.9 Backfilling.**

**A.** After a structure has been completed, the area around it shall be backfilled with approved material, in horizontal layers not to exceed 8 inches in loose depth and compacted to the density required in Item P-152. Each layer shall be deposited evenly around the structure to approximately the same elevation. The top of the fill shall meet the elevation shown on the plans or as directed by the ENGINEER.

**B.** Backfill shall not be placed against any structure until approved by the ENGINEER. For concrete structures, approval shall not be given until the concrete has been in place seven (7) days, or until tests establish that the concrete has attained sufficient strength to withstand any pressure created by the backfill and placing methods.

**C.** Backfill shall not be measured for direct payment. Performance of this work shall be considered an obligation of the Contractor covered under the contract unit price for the structure involved.

**751-3.10 Cleaning and Restoration of Site.** After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as approved by the ENGINEER. The Contractor shall restore all disturbed areas to their original condition. The Contractor shall remove all tools and equipment, leaving the entire site free, clear, and in good condition.

### **METHOD OF MEASUREMENT**

**751-4.1** Manholes, catch basins, inlets, and inspection holes shall be measured by the unit.

### **BASIS OF PAYMENT**

**751-5.1** The accepted quantities of manholes, catch basins, inlets, and inspection holes will be paid for at the contract unit price per each in place when completed. This price shall be full compensation for furnishing all materials and for all preparation, excavation, backfilling and placing of the materials; furnishing and installation of such specials and connections to pipes and other structures as may be required to complete the item as shown on the plans; and for all labor equipment, tools and incidentals necessary to complete the structure. Payment will be made under:

Item D-751.5.1 PVC Drainage Basin - per Each

Item D-751.5.2 Pre-Cast Concrete Drop Inlet - per Each

### **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 A27	Standard Specification for Steel Castings, Carbon, for General Application
ASTM A47	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A897	Standard Specification for Austempered Ductile Iron Castings
ASTM C32	Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150	Standard Specification for Portland Cement
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C913	Standard Specification for Precast Concrete Water and Wastewater Structures.

**American Association of State Highway and Transportation Officials (AASHTO)**

AASHTO M36	Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
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**END OF ITEM D-751**

**SECTION PEB**  
**PRE-ENGINEERED BUILDING (T-HANGAR)**  
**PART 1 - GENERAL.**

**1.01 REFERENCE STANDARDS:**

- A.** American Iron and Steel Institute (AISI):
  - 1. Specifications for the Design of Cold Formed Steel Structural Members, latest edition.
- B.** American Institute of Steel Construction (AISC):
  - 1. Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings, latest edition.
- C.** American Welding Society (AWS):
  - 1. Specification for Welding and Building Construction, latest edition.
- D.** American Society for Testing and Materials (ASTM):
  - 1. A 307-Latest Edition Carbon Steel Externally and Internally Threaded Standard Fasteners.
  - 2. A 325- Latest Edition High Strength Bolts for Structural Steel Joints, Including Suitable Nuts and Plain Hardened Washers.
  - 3. A 525- Latest Edition Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process.
  - 4. A 446- Latest Edition Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.
  - 5. A 36- Latest Edition Structural Steel.
  - 6. A 572- Latest Edition High Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality.
  - 7. A 607- Latest Edition Steel Sheet and Strip, Hot Rolled and Cold-Rolled, High Strength, Low-Alloy Columbium and/or Vanadium.
  - 8. A-615-16 – Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

9. 1064-17 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete.
- E. Metal Building Manufacturers Association (MBMA):
  1. Metal Building Systems Manual
- F. Steel Door Institute (SDI):
  1. SDI 100- Latest Edition Recommended Specifications, Standard Steel Doors and Frames.
- G. Steel Structures Painting Council (SSPC):
  1. Steel Structures Painting Manual, Volume 2, Systems and Specifications, Latest Edition.
- H. American National Standards Institute (ANSI):
  1. A 156.2- Latest Edition Locks and Lock Trim.
  2. A 156.4- Latest Edition Door Controls and Closers.

#### **1.02 SUBMITTALS:**

- A. Building Shop Drawings: Contractor shall submit shop drawings showing materials and method of construction. Shop drawings should show floor plan, foundation plan, anchor bolt settings; sidewall, endwall, and roof framing; cross sections; wall covering; roof covering; flashing details, sealants, accessory installation details; door details, and installation; and preparation for the work of other trades. The shop drawing package shall include full details for all hangar doors and overhead doors, including associated hardware and, if electrically operated, all electrical components and wiring information.
- B. Submit design drawings and calculations for the building and foundations sealed by a structural Professional Engineer registered in the State of North Carolina, confirming that the building design meets the requirements of the applicable specifications, building system manual of MBMA, and that the design is in conformance with local building codes and the North Carolina State Building code, International Building Code (IBC) and ADA standards. The drawings must show all dimensions, size members, type of connection, foundation and slab layout, etc. Calculations must clearly show all input parameters, load computations, and final loadings for columns.
- C. Roof and Building Weather Tightness Endorsement: Submit weather

tightness warranty cosigned by the building manufacturer and Contractor agreeing to repair and stop roof leaks and other leaks in the hangar building at no cost to the Owner for a period of five (5) years from date of final acceptance.

- D. Building shop drawings shall be submitted within 30 days of delivery of the executed contract to the contractor. A delivery schedule shall be included with the shop drawings.

## **PART 2 - PRODUCTS**

### **2.01 DESCRIPTION:**

- A. The hangar buildings shall be of pre-engineered metal building construction and shall be configured in general conformance with the plans for the following hangars:

1. 12-Unit T-Hangar with Bi-Fold Doors
2. 10-Unit T-Hangar with Bi-Fold Doors

The hangar unit shall be designed to provide the minimum clear dimensions and opening as shown on the plans.

- B. The building manufacturer shall have been regularly engaged in metal building and aircraft hangar production for not less than 5 years. The Contractor shall submit with his bid information the name and background of the manufacturer along with a list of similar installations showing date of installation, location, and contact person for reference. After performing an investigation of prior installations, the Owner shall have the right to reject any manufacturer that it determines to be unqualified or unsatisfactory. Hangar manufacturer shall concur in the acceptability of hangar doors as provided.
- C. The hangar door manufacturer shall have been regularly engaged in hangar door production for not less than 10 years. The Contractor shall submit with his bid information the name and background of the manufacturer along with a list of similar installations showing date of installation, location, and contact person for reference. After performing an investigation of prior installations, the OWNER shall have the right to reject any manufacturer that it determines to be unqualified or unsatisfactory.

### **2.02 DESIGN BASIS:**

- A. Design light gauge structural members in accordance with AISI "Specification for the Design of Cold-Formed Steel Structural Members," latest edition.

- B.** Design structural steel sections and welded plate members in accordance with AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings," latest edition.
- C.** Building Design shall be in compliance with the North Carolina State Building Code, latest edition.

  - 1. Building elements shall be designed to resist loading combinations as specified in North Carolina State Building Code.
  - 2. Framing for doors, window, and louver openings shall be designed to structurally replace the wall panels and framing the openings displace and to carry any additional loads as required by the doors, etc.
  - 3. Interior partitions shall be designed to support 5 PSF (minimum) uniform load.
  - 4. Building System shall be designed to meet the requirements of UL 580 "Standard for Tests for Uplift Resistance of Roof Assemblies" with a Class 90 rating.
- D.** The slab/foundation shown on the plans is for reference only and is based on assumed column locations, estimated column reactions and a soil bearing value of 2,000 lbs/S.F. When the Contractor submits the shop drawings and design calculations for the building system proposed, the Contractor shall also submit a foundation and slab designed to suit the column locations and reactions for the proposed building system. The foundation and slab shall be designed and sealed by a Professional Engineer Registered in the State of North Carolina. The foundation as revised shall be constructed by the Contractor at no additional expense to the Owner, except for the adjustment in the volume of concrete as outlined in paragraph F below.
- E.** Prior to placement of the foundation the Owner's testing laboratory shall be given the opportunity to determine the adequacy of the foundation material to support the intended and future loadings. Determination of foundation adequacy shall not be made until such time as the excavation for the placement of the building foundation has been made. Upon visual observation and any required subsequent testing, the testing laboratory shall confirm the suitability of the foundation material to accept the loading.
- F.** For bidding purposes, the foundations have been designed and detailed based on a bearing value of 2,000 lb./S.F. and estimated column loads. Once the building design calculations have been completed, adjustments



to the foundation may be made based on actual loads, and bearing values. Slab layout and size are also subject to change based on actual building dimensions. The proposal form has an item for adjusting the lump sum price bid for the Hangar for concrete foundations and slab, per cubic yard that will be used to adjust the lump sum price as either an addition or deduction based upon the final footing design and approved building layout. The unit price per cubic yard shall include all costs for concrete, reinforcing steel, forms, accessories, and labor associated with foundation and slab construction.

- G. Building and foundation design shall be completed in compliance with Seismic Site Class D.

## **2.03 STRUCTURAL MATERIALS;**

- A. Structural Frame Members: ASTM A36; hot rolled, cold formed or welded, built-up shapes.
- B. Purlins, Girts, Eave Struts: Manufacturers' standard roll formed sections, conforming to ASTM A570. Brace rods shall conform to ASTM A 572.
- C. Shop Connections: All bolted. Bolts shall be machine bolts conforming to ASTM A307 or ASTM A325 as shown on the manufacturer's building drawings. A325 bolts shall be tightened by the turn-of-the-nut method. Where required, connections in secondary members shall be made with special ½ inch oval head, high strength bolts with hex nuts. The faying surfaces of all bolted connections shall be smooth and free from burrs or distortions. All bolts shall be electro-zinc plated.
- D. Shop Painting: All structural framing members which are not galvanized shall be cleaned according to SSPC-SPI and either SSPC-SP3 or SSPC-SP7. Apply two shop coats of FS TT-P-636 red primer @ 1.5 mils DFT. The first coat shall be applied the same day the steel is cleaned.

After erection of the structural framework, all burned, scratched, or damaged areas shall be touched up with the same primer.

## **2.04 ROOF AND WALL COVERING**

- A. Roof Panels: Minimum 26 gauge (Galvalume) aluminum-zinc coated steel coating @ 1.25 ounce per square foot (minimum). Roof panels shall have 1-1/8 inch deep (minimum) ribs at 12" on centers with two intermediate stiffener ribs. Minimum width shall be 36" and length shall be ridge to eave.
- B. Base Material for Exterior Wall Panels: Minimum 26 gauge galvanized steel; 1-1/8 inch deep ribs (minimum) at 8 inches on centers. (Minimum

width shall be 36" and minimum length shall be ground to eave.) Base angle for exterior (perimeter) wall panels shall be minimum 18 gauge galvanized steel.

- C.** Interior Partitions: Shall be minimum 28-gauge Galvalume corrugated steel. Interior partitions shall be full height, extending upward to fit flush with the roof panels and securely connected to floor base sill angle. Base angle for interior partitions shall be as detailed on the plans. The partitions shall extend the full width of the hangar building so as to fully isolate each unit from adjacent units. The top closure of the partitions may be in the form of the partition panels extending flush to the roof panels or the partition panels being attached to flush roof framing members (purlins, beams, etc.) or closure angles, such that no gap exists at the top of the partition.
- D.** Base Material for Flashing and Metal Trim: 26 gauge galvanized steel (ASTM A 525, G90).
- E.** Finish for All Exterior Wall Panels, Flashing, Soffit, Eave, and Metal Trim: Outside (weatherside) shall be thermo-setting silicone polyester 1 mil DFT. Inside or concealed side of metal panels shall be .5 mil polyester coating. Colors shall be selected by the Owner from available stock colors.
- F.** Roof and wall panels shall be guaranteed against checking, peeling, blistering, chalking, or fading for a period of 15 years.
- G.** Fastenings: All sheet metal screws shall be self tapping, hex-head screws with a corrosion resisting coating. A self-sealing washer shall be used under the head of all roof panel fasteners. Plated colored screws shall be used on all side wall connections. The color of these screws shall match the color of the side walls.
- H.** Provide flashing, sealant, or closures at all exterior joints to give a neat, air tight joint. Sealant for side laps, end laps and flashing shall be a grey pressure sensitive butyl-EPDM rubber tape. Provide continuous tape sealant at all roof panel joints. A rubber or neoprene seal shall also be installed along the rake and eave of roof panels for water tight seal.
- I.** The junctures between roof and walls and walls and floors shall be made watertight with closure strips.

## **2.05 DOORS:**

- A.** Personnel Doors installed in the bi-fold hangar door shall be heavy duty 24 gauge galvanized smooth steel panels with a heavy duty 16-gauge galvanized steel frame jamb. Door provided shall be 6'-8" height and 3'-0" wide. Doors supplied with the project shall be Series 5100 doors as

manufactured by A.J. Manufacturing, Inc., Bloomer, Wisconsin (800) 328-9447 or approved equal.

- B.** Personnel Doors installed in the hangar electrical room and bathroom shall be heavy duty 20 gauge galvanized smooth steel panels with a heavy duty 16-gauge galvanized steel frame jamb, bulb weather-stripping, ADA compliant threshold and non-removable pin hinges. Door provided shall be 6'-8" height and 3'-0" wide. Doors supplied with the project shall be Tioga Doors doors as manufactured by Tell Manufacturing, Inc., Lititz, Pennsylvania (800)-433-4047 or approved equal.

**C.** Door Hardware:

1. Lockset: ANSI A 156.2, series 4000 (bored), grade 1; ANSI finish US32D, Satin Finish Stainless Steel.
  - a. Provide dwelling entrance operation (latchbolt retracted by either lever, unless outside lever is locked by thumb turn on inside or key on the outside) at personnel doors for hangars
3. Keying:
  - a. Personnel doors for hangars shall be keyed individually with a master key which fits all doors.

**D.** Installation:

1. Comply with manufacturer's recommendations and specifications for the installation of the doors and frames. Factory install hardware, glass, and louvers in doors.
2. Set units plum, level, and true to line, without warp or rack of doors or frames. Anchor securely in place. Separate aluminum and other metal surfaces with bituminous coatings or other means as recommended by manufacturer.
3. Set thresholds in a bed of mastic and backseal.
4. Clean surfaces promptly after installation of doors and frames, exercising care to avoid damage to the protective coatings.
5. Ensure that the doors and frames will be without damage or deterioration (other than normal weather) at the time of acceptance.
6. Provide OWNER with all adjustment tools and instruction sheets. Arrange an in-service session to OWNER at OWNER'S

convenience. Provide a minimum one-year written warranty on all labor related to this section. Any workmanship which is defective or deficient shall be corrected to the OWNER'S satisfaction and at no additional cost to the OWNER.

## **2.06 ACCESSORIES:**

- A. A continuous airflow ridge cap shall be provided consisting of 26 ga. Galvalume or color finish ridge vent cap, ProfileVent ventilation core, roof sealant and mounting components.

## **2.07 ROOF INSULATION (ALTERNATE ITEM).**

These alternate bid items shall include installation of insulation in the hangar roof.

- A. **Insulation:** Fiberglass shall be as outlined in the North American Insulation Manufacturing Association (NAIMA 202-96) specification, or equal, with an R-value of R-13 when not compressed. The fiberglass shall be faced with WMP-10, as specified below, on one side. The composite of fiberglass and facing shall have surface burning characteristics not to exceed 25 flame spread and 50 smoke developed when tested in accordance with Underwriters Laboratories 723 test method or ASTM E 84 test method.
- B. **Facing:** Facing shall be composed of 0.0015" white metallized polypropylene film, a reinforcing layer and 14# kraft paper. The product shall be reinforced with a 5x5 tri-directional scrim which has a blend of fiberglass and polyester yarns. The resulting facing shall have a water vapor transmission rate of 0.02 US perm (ASTM E96, Procedure A), a beach puncture of 125 scale units and a mullen burst of 65 psi. Tensile strength shall be 40# in the machine direction and 35# in the cross-machine direction. The manufacturer's name and product identification must be printed on the tab area of the facing.

## **2.08 HANGAR DOORS - ELECTRIC BI-FOLD:**

- A. Hangar doors shall be of the electric bi-fold canopy type, made in two sections, hinged at the top to building truss and hinged at the horizontal center line. Doors shall be assembled into a welded frame of light gauge aluminum or steel tubing. Each electric bi-fold door shall be equipped with one 3'0" x 6'6" (min.) aluminum pre-finished personnel door with cylindrical lock and master keyed. For the 3'0" x 6'6" personnel doors, provide 2 keys to each door and 2 master keys for all locks. Electric bi-fold doors shall be installed on the 12-unit T-hangar and the 10-unit T-Hangar.
- B. Design of the Hangar doors shall be coordinated by/with the manufacturer of the building structural system for complete integration.

- C. The door framing shall be designed to carry its own dead load and resist horizontal wind pressure as specified by code.
- D. The door header structure shall be designed to support roof, dead, live, and winds loads plus the door dead load and transmit door wind load to the building braced bays. Deflection of these members shall be combined with those of the door frame columns and not exceed the deflection capacity of the door guide system.
- E. Hangar door exterior panels and trim shall match building wall panels.
- F. All door framing shall be shop primed the same as the structural framing members.
- G. Lifting device shall be at least a 3/4 h.p., 240-volt, single phase motor with thermal overload protection designed specifically for the door by the manufacturer to provide long-term reliable service. Door and motor system shall have a minimum 3-year warranty. All doors shall come complete with all necessary switch(es) and control devices, aircraft type lift cables and sheave wheels. Top mounted motors are preferred. Motors mounted near the bottom of the door and associated wiring shall be explosion proof, rated for Class I, Division 2 locations (see Paragraph 2.11). Switches shall be explosion proof and shall operate on low voltage control circuitry, complete with the necessary transformer, relays, etc. The doors shall have a safety provision for downward door travel. This may take the form of optical or mechanical sensing devices which stop/reverse the downward travel or a constant pressure type down switch (the door stops when the button is released). All door control components and wiring shall be suitable for Class I, Division 2 locations, unless located above the clear door opening height (see Paragraph 2.11).
- I. Bi-fold doors shall be fitted with weather seal at the top and bottom and lap columns for a weather tight structure.
- J. Door manufacturer shall provide all equipment necessary for installation of door. Shop drawings shall be submitted in accordance with Paragraph 1.02A and shall indicate tolerances for installation.

## **2.09 HANGAR ELECTRICAL WORK:**

- A. All electrical work shall be performed as shown and specified on the electrical drawings and in accordance with the provisions of the National Electric Code (NEC) and in accordance with the electrical plans and specifications which are incorporated as part of the set of contract documents.

## **2.10 FOUNDATION AND SLAB CONCRETE:**

- A.** Foundation and slab concrete: All concrete shall be in accordance with the following:

Class C: Normal-weight concrete used for interior slabs-on-ground and tie-beams.

1. Exposure Class: ACI 318 F0, S0, W0, C0.
  2. Minimum Compressive Strength: 4,500 at 28 days.
  3. Maximum w/cm: 0.45.
  4. Minimum Cementitious Materials Content: 540 lb/cu. yd.
  5. Slump Limit: 4 inches, plus or minus 1 inch, before adding high-range water-reducing or plasticizing admixtures at the Project site (8 inches, plus or minus 1 inch thereafter).
  6. Air Content: Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
  7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
- B.** Finish floor surfaces: Concrete floors shall be finished with a steel trowel. Finish floor surfaces of hangar shall be treated with a curing, hardening, and sealing compound, such as Sealtight CS-309, as manufactured by W.R. Meadows, or equivalent.
- C.** Alternate floor finish: The OWNER may elect to have a urethane/epoxy floor coating provided in the hangar units. The floor coating shall be resistant to aviation and jet fuel and hydraulic brake fluids. The Contractor shall modify curing compound applications to be compatible with floor coating application. Contractor shall strictly adhere to manufacturers requirements for cleaning the floor surface and floor temperature limitations prior to application of the floor coating. Atmospheric, floor and material temperatures as well as moisture should always be considered before applying any floor coating product. Urethane floor coating shall be Devfloor 566 Chemical Resistant Urethane manufactured by Devoe High Performance Coatings or approved equal. Epoxy floor coating shall be Devfloor 525 100% Solids Epoxy Resurfacer manufactured by Devoe High Performance Coatings or approved equal.
- D.** Form and Slab Elevation Verification: The Contractor shall verify form elevations prior to beginning concrete placement operations. Elevations shall be taken at a spacing not to exceed ten (10) feet along all form edges. Elevations shall be within 1/4" of plan elevation. Verification elevations shall be provided to Engineer for review prior to concrete placement.
- E.** Slab Flatness. The slab surface finish shall be checked with a ten (10) foot

straight edge applied to the surface. The finished surface shall not vary more than 1/4" when tested with the straightedge. Contractor shall provide a ten (10) foot straightedge to be used in performing the surface tests.

### **PART 3 - EXECUTION**

#### **3.01 ERECTION OF PRE-ENGINEERED BUILDING:**

- A.** Roof Covering: All panels shall be properly positioned and aligned prior to drilling and fastening. All side laps will be field sealed by a non-hardening tape sealant. All side lap sealant shall be factory applied. Panel laps shall be at least 6", sealed with manufacturer recommended sealants and fastened together as recommended by the manufacturer.
- B.** Wall panels shall be applied to the structural frame with the ribs toward the exterior or interior of the structure. Panels shall be fastened at the base, at the eave and rake, to each intermediate girt by means of manufacturer's standard fasteners previously specified. Wall panels shall be applied with no horizontal laps.
- C.** The junctures between roof and walls and between walls and floors shall be closed with closure strips.
- D.** Flashing and trim metal shall be furnished wherever necessary to provide weather tightness and a finished appearance.
- E.** During erection, Contractor shall check and verify plumbness and squareness of building components as appropriate. Contractor shall correct all deficiencies found prior to installation of wall and roof panels.

#### **3.02 FIELD PAINTING:**

- A.** Touch up the shop coat on the interior structural steel members including rigid frames, purlins, girts, bracing, plates, bolts, and struts with compatible paint.
- B.** Finish coats for field painted metal surfaces shall be alkyd enamel, Sherwin-Williams Metalastic II, PPG 6-252 Series, Glidden 4500 Series, or approved equal.
- C.** All metal surfaces that are not corrosion resistant or only have primer coat that can be exposed to the elements will be painted with 2 finish coats, as specified above. Colors to be selected by the Owner.

## **PART 4 - BASIS OF PAYMENT**

### **4.01 BASIS OF PAYMENT:**

- A.** Payment for the Slab and Foundation for the 12-Unit and 10-Unit T-Hangars shall be on a lump sum basis. This price shall include but not be limited to foundation designed by a Professional Engineer Registered in the State of North Carolina for the building system proposed by the contractor, all fine grading, compaction, excavation, providing all base stone, concrete reinforcement, wire fabric, anchor bolts, expansion joint material, vapor barrier, curing compound/cover material, forms, finishing all labor, materials, equipment, and incidentals necessary to acceptably complete the work.
- B.** Payment for the 12-Unit and 10-Unit T-Hangars with Bi-fold Doors shall be on a lump sum basis. This price shall include all labor, materials, equipment, hangar doors, and other incidentals (except electrical wiring and conduit) necessary to satisfactorily complete a useable hangar building in accordance with the plans and specifications.
- C.** Payment for the Electrical Service Installation for the 12-Unit and 10-Unit T-Hangars shall be on a lump sum basis. This price shall include all labor, materials, equipment, including but not limited to wiring, conduits, panels, and enclosures in accordance with the hangar electrical plans and specifications.
- D.** Payment for the T-Hangar Electrical Installation for the 12-Unit and 10-Unit T-Hangars shall be on a lump sum basis. This price shall include all labor, materials, equipment, including wiring, conduits, overhead lights, outlets, switches, hangar door motors, and other incidentals necessary to satisfactorily provide a complete and operational electrical system including but not limited to all overhead lights, electric hangar doors, outlets in accordance with the hangar electrical plans and specifications.
- E.** BID ALTERNATE: Payment for Roof Insulation for the 12-Unit and 10-Unit T-Hangars shall be on a lump sum basis. This price shall include all labor, materials, equipment and all incidentals necessary to provide a complete installation of roof insulation on all hangars units included in the bid item.
- F.** BID ALTERNATE: Payment for Urethane/Epoxy Floor Coating for the 12-unit and 10-Unit T-Hangars shall be on a lump sum basis. This price shall include all labor materials, equipment and all incidentals necessary to provide a complete installation of the floor covering on all hangars units included in the bid item.
- G.** Payment for addition or deletion Concrete for Foundations and Slab shall



be made on a per cubic yard basis. This item will be used to address changes in the concrete necessary for construction of the building slab and foundations based on the final design submitted by the contractor and approved by the Engineer. The volume of concrete for the final slab and foundation design will be compared with the volume of concrete for the slab and foundation details included in the project plans. Where an increase in the concrete is required, additional payment will be made to the contractor based on this unit price. Where a decrease in the concrete is required, a reduction in payment will be made based on this unit price. This price shall include all labor, materials, equipment and all incidentals necessary to complete this item of work.

**4.02 PAYMENT WILL BE MADE UNDER:**

- Item Slab and Foundation for 12-Unit T-Hangar – per Lump Sum
- Item 12-Unit T-Hangar with Bi-fold Doors – per Lump Sum
- Item Electrical Service Installation for 12-Unit T-Hangar – per Lump Sum
- Item T-Hangar Electrical Installation for 12-Unit T-Hangar – per Lump Sum
- Item Slab and Foundation for 10-Unit T-Hangar – per Lump Sum
- Item 10-Unit T-Hangar with Bi-fold Doors – per Lump Sum
- Item Electrical Service Installation for 10-Unit T-Hangar – per Lump Sum
- Item T-Hangar Electrical Installation for 10-Unit T-Hangar – per Lump Sum

Bid Alternate Items

- Item Add for Roof Insulation for 12-Unit T-Hangar – per Lump Sum
- Item Add for Roof Insulation for 10-Unit T-Hangar – per Lump Sum
- Item Add for Urethane/Epoxy Floor Coating for 12-Unit T-Hangar – per Lump Sum
- Item Add for Urethane/Epoxy Floor Coating for 10-Unit T-Hangar – per Lump Sum
- Item Add/Deduct for Concrete for Foundations and Slab – per Cubic Yard

**END OF ITEM PEB**

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**ITEM T-901****SEEDING****DESCRIPTION**

- 901-1.1** This item shall consist of soil preparation, seeding, fertilizing, and liming the areas shown on the plans or as directed by the ENGINEER in accordance with these specifications.

**MATERIALS**

- 901-2.1 Seed.** The species and application rates of grass, legume, and cover-crop seed furnished shall be those stipulated herein. Seed shall conform to the requirements of Federal Specification JJJ-S-181, Federal Specification, Seeds, Agricultural.

Seed shall be furnished separately or in mixtures in standard containers labeled in conformance with the Agricultural Marketing Service (AMS) Seed Act and applicable state seed laws with the seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the ENGINEER duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within six (6) months of date of delivery. This statement shall include: name and address of laboratory, date of test, lot number for each kind of seed, and the results of tests as to name, percentages of purity and of germination, and percentage of weed content for each kind of seed furnished, and, in case of a mixture, the proportions of each kind of seed. Wet, moldy, or otherwise damaged seed will be rejected.

**Permanent Seeding**

<b>Seeding Mixture</b>	<b>Rate of Application (lb/acre)</b>	<b>Planting Dates</b>
Common Bermudagrass (Hulled)	50	April 1 - August 31
Common Bermudagrass (Unhulled)	70	September 1 – March 31

**Temporary Seeding**

Rye (Grain)	120	December 1 – March 31
Kobe Lespedeza	50	
Hulled Bermudagrass	50	April 1 – August 31
Rye (Grain)	120	September 1 – November 30

**901-2.2 Lime.** Lime shall be ground limestone containing not less than 85% of total carbonates, and shall be ground to such fineness that 90% will pass through a No. 20 mesh sieve and 50% will pass through a No. 100 mesh sieve. Coarser material will be acceptable, providing the rates of application are increased to provide not less than the minimum quantities and depth specified in the special provisions on the basis of the two sieve requirements above. Dolomitic lime or a high magnesium lime shall contain at least 10% of magnesium oxide. Lime shall be applied at the rate of 3,000 lbs/acre. All liming materials shall conform to the requirements of ASTM C602.

**901-2.3 Fertilizer.** Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate and to the depth specified and shall meet the requirements of applicable state laws. They shall be furnished in standard containers with name, weight, and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

The fertilizers may be supplied in one of the following forms:

**A.** A dry, free-flowing fertilizer suitable for application by a common fertilizer spreader; or

**B.** A finely-ground fertilizer soluble in water, suitable for application by power sprayers; or

**C.** A granular or pellet form suitable for application by blower equipment.

Fertilizers shall be 10-10-10 commercial fertilizer and shall be spread at the rate of 500 lbs/acre.

**901-2.4 Soil for Repairs.** The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the ENGINEER before being placed.

## CONSTRUCTION METHODS

**901-3.1 Advance Preparation and Cleanup.** After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be raked or otherwise cleared of stones larger than 2 inches in any diameter, sticks, stumps, and other debris that might interfere with sowing

of seed, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage include filling gullies, smoothing irregularities, and repairing other incidental damage.

An area to be seeded shall be considered a satisfactory seedbed without additional treatment if it has recently been thoroughly loosened and worked to a depth of not less than 5 inches as a result of grading operations and, if immediately prior to seeding, the top 3 inches of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter, and if shaped to the required grade.

When the area to be seeded is sparsely sodded, weedy, barren, and unworked, or packed and hard, any grass and weeds shall first be cut or otherwise satisfactorily disposed of, and the soil then scarified or otherwise loosened to a depth not less than 5 inches. Clods shall be broken, and the top 3 inches of soil shall be worked into a satisfactory seedbed by disking, or by use of cultipackers, rollers, drags, harrows, or other appropriate means.

#### **901-3.2 Dry Application Method.**

**A. Liming.** Lime shall be applied separately and prior to the application of any fertilizer or seed and only on seedbeds that have previously been prepared as described above. The lime shall then be worked into the top 3 inches of soil after which the seedbed shall again be properly graded and dressed to a smooth finish.

**B. Fertilizing.** Following advance preparations and cleanup fertilizer shall be uniformly spread at the rate that will provide not less than the minimum quantity stated in Paragraph 901-2.3.

**C. Seeding.** Grass seed shall be sown at the rate specified in Paragraph 901-2.1 immediately after fertilizing. The fertilizer and seed shall be raked within the depth range stated in the special provisions. Seeds of legumes, either alone or in mixtures, shall be inoculated before mixing or sowing, in accordance with the instructions of the Manufacturer of the inoculant. When seeding is required at other than the seasons shown on the plans or in the special provisions, a cover crop shall be sown by the same methods required for grass and legume seeding.

**D. Rolling.** After the seed has been properly covered, the seedbed shall be immediately compacted by means of an approved lawn roller, weighing 40 to 65 pounds per foot of width for clay soil (or any soil having a tendency to pack), and weighing 150 to 200 pounds per foot of width for sandy or light soils.

### **901-3.3 Wet Application Method.**

**A. General.** The Contractor may elect to apply seed and fertilizer (and lime, if required) by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as specified in the special provisions.

**B. Spraying Equipment.** The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons per minute at a pressure of 100 pounds / square inch. The pump shall be mounted in a line that will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipelines shall be capable of providing clearance for 5/8 inch solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 to 100 feet. One shall be a close-range ribbon nozzle, one a medium-range ribbon nozzle, and one a long-range jet nozzle. For ease of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet in length shall be provided to which the nozzles may be connected.

**C. Mixtures.** Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 pounds of lime shall be added to and mixed with each 100 gallons of water. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds of these combined solids shall be added to and mixed with each 100 gallons of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. The Contractor shall identify to the ENGINEER all sources of water at least two (2) weeks prior to use. The ENGINEER may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source that is disapproved by the ENGINEER following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within two (2) hours from the time they were mixed, or they shall be wasted and disposed of at approved locations.

**D. Spraying.** Lime, if required, shall be sprayed only upon previously prepared seedbeds. After the applied lime mixture has dried, the lime shall be worked into the top 3 inches, after which the seedbed shall again be properly graded and dressed to a smooth finish.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds on which the lime, if required, shall already have been worked in. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with specifications shall be used to cover specified sections of known area.

Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

On surfaces that are to be mulched as indicated by the plans or designated by the ENGINEER, seed and fertilizer applied by the spray method need not be raked into the soil or rolled. However, on surfaces on which mulch is not to be used, the raking and rolling operations will be required after the soil has dried.

**901-3.4 Establishment of Seeded Areas (Watering).** The Contractor is required to establish a good stand of permanent grass of uniform color and density to the satisfaction of the ENGINEER. In the event that normal rainfall is not adequate for the germination and establishment of good stand of permanent grass, the OWNER will pay for watering up to the amount shown in the contract

documents (but not exceeding), based on a watering rate for the permanent seed (bermudagrass) of  $\frac{1}{4}$ " of water every 3 or 4 days for 3 weeks.

The Contractor is responsible for checking the dryness of the soil on a regular basis to determine the amount of irrigation needed to sustain sufficient growth. Watering shall be done in a manner that will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface from the watering itself or from the water truck. The Contractor shall use a water cannon, large area mobile irrigation system, or other approved equipment to eliminate/reduce potential rutting of the finished/seeded ground surface. Watering must be performed in accordance with the requirements of the Safety Plans and schedule/location shall be coordinated with the ENGINEER. The Contractor will be responsible for providing a water source. Payment will only be made for the watering of permanent seed/grass as outlined in Paragraph 901-4.2.

**901-3.5 Maintenance of Seeded Areas.** The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the ENGINEER. Surfaces gullied or otherwise damaged following seeding shall be repaired by regrading and reseeding as directed. The Contractor shall mow, water as directed, and otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the work.

When either the dry or wet application method outlined above is used for work done out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the ENGINEER. A grass stand shall be considered adequate when bare spots are one square foot or less, randomly dispersed, and do not exceed 3% of the area seeded.

#### **METHOD OF MEASUREMENT**

**901-4.1** The quantity of seeding to be paid for shall be the number of acres measured on the ground surface, completed, and accepted.

**901-4.2** The quantity of Watering to be paid for will be the actual number of 1,000 gallon units of water, up to the quantity shown in the contract documents, which have been satisfactorily and uniformly applied to the site. Any amount of water that may be needed beyond the contract quantity will be performed by the Contractor at his expense. The OWNER will not pay for any quantity of water greater than the quantity in the contract. Measurement of water will be made by means of determining the volumetric capacity of the tanks/trucks used to deliver water to the project and recording the number of loads delivered by each truck. The Contractor will ensure the quantity of each tank/truck of water is verified and recorded by the on-site Resident Project Representative or the OWNER's designated representative. Failure to obtain verification and



recording of the volume of each tank/truck shall to sufficient grounds for the OWNER to disallow payment.

### **BASIS OF PAYMENT**

**901-5.1** Payment shall be made at the contract unit price per acre or fraction thereof, which price and payment shall be full compensation for furnishing and placing all material and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

**901-5.2** Payment for Watering shall be made at the contract unit price per 1,000 gallons or fraction thereof, which price and payment shall be full compensation for furnishing and applying all water and for all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this item.

Payment will be made under:

Item 901.5.1      Seeding – per Acre

Item 910.5.2      Watering – per 1,000 Gallons

### **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 C602      Standard Specification for Agricultural Liming Materials

#### **Federal Specifications (FED SPEC)**

FED SPEC      JJJ-S-181, Federal Specification, Seeds, Agricultural

#### **Advisory Circulars (AC)**

AC 150/5200-33C Hazardous Wildlife Attractants on or Near Airports

#### **FAA/United States Department of Agriculture**

Talbert & Bright

**Wildlife Hazard Management at Airports, A Manual for Airport Personnel**

**END OF ITEM T-901**

## ITEM T-904

### SODDING

#### DESCRIPTION

- 904-1.1** This item shall consist of furnishing, hauling, and placing approved live sod on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the ENGINEER.

#### MATERIALS

- 904-2.1 Sod.** Sod furnished by the Contractor shall have a good cover of living or growing grass. This shall be interpreted to include grass that is seasonally dormant during the cold or dry seasons and capable of renewing growth after the dormant period. All sod shall be obtained from areas where the soil is reasonably fertile and contains a high percentage of loamy topsoil. Sod shall be cut or stripped from living, thickly matted turf relatively free of weeds or other undesirable foreign plants, large stones, roots, or other materials that might be detrimental to the development of the sod or to future maintenance. At least 70% of the plants in the cut sod shall be composed of the species stated in the special provisions, and any vegetation more than 6 inches in height shall be mowed to a height of 3 inches or less before sod is lifted. Sod, including the soil containing the roots and the plant growth showing above, shall be cut uniformly to a thickness not less than that stated in the special provisions. Sod shall be Bermuda.
- 904-2.2 Lime.** Lime shall conform to requirements of T-901-2.2.
- 904-2.3 Fertilizer.** Fertilizer shall conform to the requirements of T-901-2.3.
- 904-2.4 Water.** The water shall be sufficiently free from oil, acid, alkali, salt, or other harmful materials that would inhibit the growth of grass.
- 904-2.5 Soil for Repairs.** The soil for fill and topsoiling of areas to be repaired shall be at least of equal quality to that which exists in areas adjacent to the area to be repaired. The soil shall be relatively free from large stones, roots, stumps, or other materials that will interfere with subsequent sowing of seed, compacting, and establishing turf, and shall be approved by the ENGINEER before being placed.

#### CONSTRUCTION METHODS

- 904-3.1 General.** Areas to be solid, strip, or spot sodded shall be shown on the plans. Areas requiring special ground surface preparation such as tilling and those

areas in a satisfactory condition that are to remain undisturbed shall also be shown on the plans.

Suitable equipment necessary for proper preparation of the ground surface and for the handling and placing of all required materials shall be on hand, in good condition, and shall be approved by the ENGINEER before the various operations are started. The Contractor shall demonstrate to the RPR/ENGINEER before starting the various operations that the application of required materials will be made at the specified rates.

**904-3.2 Preparing the Ground Surface.** After grading of areas has been completed and before applying fertilizer and limestone, areas to be sodded shall be raked or otherwise cleared of stones larger than 2 inches in any diameter, sticks, stumps, and other debris which might interfere with sodding, growth of grasses, or subsequent maintenance of grass-covered areas. If any damage by erosion or other causes occurs after grading of areas and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage. This may include filling gullies, smoothing irregularities, and repairing other incidental damage.

**904-3.3 Applying Fertilizer and Ground Limestone.** Following ground surface preparation, fertilizer shall be uniformly spread at a rate which will provide not less than the minimum quantity of each fertilizer ingredient, as stated in the special provisions. If use of ground limestone is required, it shall then be spread at a rate that will provide not less than the minimum quantity stated in the special provisions. These materials shall be incorporated into the soil to a depth of not less than 2 inches by discing, raking, or other suitable methods. Any stones larger than 2 inches in any diameter, large clods, roots, and other litter brought to the surface by this operation shall be removed.

**904-3.4 Obtaining and Delivering Sod.** After inspection and approval of the source of sod by the ENGINEER, the sod shall be cut with approved sod cutters to such a thickness that after it has been transported and placed on the prepared bed, but before it has been compacted, it shall have a uniform thickness of not less than 2 inches. Sod sections or strips shall be cut in uniform widths, not less than 10 inches, and in lengths of not less than 18 inches, but of such length as may be readily lifted without breaking, tearing, or loss of soil. Where strips are required, the sod must be rolled without damage with the grass folded inside. The Contractor may be required to mow high grass before cutting sod.

The sod shall be transplanted within 24 hours from the time it is stripped unless circumstances beyond the Contractor's control make storing necessary. In such cases, sod shall be stacked, kept moist, and protected from exposure to the air and sun and shall be kept from freezing. Sod shall be cut and moved only when the soil moisture conditions are such that favorable results can be expected. Where the soil is too dry, approval to cut sod may be granted only

after it has been watered sufficiently to moisten the soil to the depth the sod is to be cut.

**904-3.5 Laying Sod.** Sodding shall be performed only during the seasons when satisfactory results can be expected. Frozen sod shall not be used, and sod shall not be placed upon frozen soil. Sod may be transplanted during periods of drought with the approval of the ENGINEER, provided the sod bed is watered to moisten the soil to a depth of at least 4 inches immediately prior to laying the sod.

The sod shall be moist and shall be placed on a moist earth bed. Pitch forks shall not be used to handle sod and dumping from vehicles shall not be permitted. The sod shall be carefully placed by hand, edge to edge and with staggered joints, in rows at right angles to the slopes, commencing at the base of the area to be sodded and working upward. The sod shall immediately be pressed firmly into contact with the sod bed by tamping or rolling with approved equipment to provide a true and even surface and ensure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Where the sod may be displaced during sodding operations, the workmen, when replacing it, shall work from ladders or treaded planks to prevent further displacement. Screened soil of good quality shall be used to fill all cracks between sods. The quantity of the fill soil shall not cause smothering of the grass. Where the grades are such that the flow of water will be from paved surfaces across sodded areas, the surface of the soil in the sod after compaction shall be set approximately one inch below the pavement edge. Where the flow will be over the sodded areas and onto the paved surfaces around manholes and inlets, the surface of the soil in the sod after compaction shall be placed flush with pavement edges.

On slopes steeper than one (1) vertical to 2-1/2 horizontal and in v-shaped or flat-bottom ditches or gutters, the sod shall be pegged with wooden pegs not less than 12 inches in length and have a cross-sectional area of not less than 3/4 square inch. The pegs shall be driven flush with the surface of the sod.

**904-3.6 Watering.** Adequate water and watering equipment must be on hand before sodding begins, and sod shall be kept moist until it has become established and its continued growth assured. In all cases, watering shall be done in a manner that will avoid erosion from the application of excessive quantities and will avoid damage to the finished surface.

**904-3.7 Establishing Turf.** The Contractor shall provide general care for the sodded areas as soon as the sod has been laid and shall continue until final inspection and acceptance of the work. All sodded areas shall be protected against traffic or other use by warning signs or barricades approved by the ENGINEER. The Contractor shall mow the sodded areas with approved mowing equipment, depending upon climatic and growth conditions and the needs for mowing

specific areas. Weeds or other undesirable vegetation shall be mowed, and the clippings raked and removed from the area.

- 904-3.8 Repairing.** When the surface has become gullied or otherwise damaged during the period covered by this contract, the affected areas shall be repaired to re-establish the grade and the condition of the soil, as directed by the ENGINEER, and shall then be sodded as specified in Paragraph 904-3.5.

### **METHOD OF MEASUREMENT**

- 904-4.1** This item shall be measured on the basis of the area in square yards of the surface covered with sod and accepted.

### **BASIS OF PAYMENT**

- 904-5.1** This item will be paid for on the basis of the contract unit price per square yard for sodding, which price shall be full compensation for all labor, equipment, material, staking, and incidentals necessary to satisfactorily complete the items as specified.

Payment will be made under:

Item T-904.5.1 Sodding (Bermuda) – per Square Yard

### **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 C602	Standard Specification for Agricultural Liming Materials
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#### **Advisory Circulars (AC)**

AC 150/5200-33C	Hazardous Wildlife Attractants on or Near Airports
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#### **FAA/United States Department of Agriculture**

**Wildlife Hazard Management at Airports, A Manual for Airport Personnel**

**END OF ITEM T-904**

## **TEM T-905**

### **TOPSOIL**

#### **DESCRIPTION**

- 905-1.1** This item shall consist of preparing the ground surface for topsoil application, removing topsoil from designated stockpiles or areas to be stripped on the site or from approved sources off the site, and placing and spreading the topsoil on prepared areas in accordance with this specification at the locations shown on the plans or as directed by the ENGINEER.

#### **MATERIALS**

- 905-2.1 Topsoil.** Topsoil shall be the surface layer of soil with no admixture of refuse or any material toxic to plant growth, and it shall be reasonably free from subsoil and stumps, roots, brush, stones (2 inches or more in diameter), and clay lumps or similar objects. Brush and other vegetation that will not be incorporated with the soil during handling operations shall be cut and removed. Ordinary sod and herbaceous growth such as grass and weeds are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means, shall be removed.

Natural topsoil may be amended by the Contractor with approved materials and methods to meet the above specifications.

- 905-2.2 Inspection and Tests.** Within 10 days following acceptance of the bid, the ENGINEER shall be notified of the source of topsoil to be furnished by the Contractor. The topsoil shall be inspected to determine if the selected soil meets the requirements specified and to determine the depth to which stripping will be permitted. At this time, the Contractor may be required to take representative soil samples from several locations within the area under consideration and to the proposed stripping depths, for testing purposes as specified in Paragraph 905-2.1.

#### **CONSTRUCTION METHODS**

- 905-3.1 General.** Areas to be topsoiled shall be shown on the plans. If topsoil is available on the site, the location of the stockpiles or areas to be stripped of topsoil and the stripping depths shall be shown on the plans.

Suitable equipment necessary for proper preparation and treatment of the ground surface, stripping of topsoil, and for the handling and placing of all required materials shall be on hand, in good condition, and approved by the ENGINEER before the various operations are started.

**905-3.2 Preparing the Ground Surface.** Immediately prior to dumping and spreading the topsoil on any area, the surface shall be loosened by discs or spike-tooth harrows, or by other means approved by the ENGINEER, to a minimum depth of 3 inches to facilitate bonding of the topsoil to the covered subgrade soil. The surface of the area to be topsoiled shall be cleared of all stones larger than 2 inches in any diameter and all litter or other material which may be detrimental to proper bonding, the rise of capillary moisture, or the proper growth of the desired planting. Limited areas, as shown on the plans, which are too compact to respond to these operations shall receive special scarification.

Grades on the area to be topsoiled, which have been established by others as shown on the plans, shall be maintained in a true and even condition. Where grades have not been established, the areas shall be smooth-graded and the surface left at the prescribed grades in an even and compacted condition to prevent the formation of low places or pockets where water will stand.

**905-3.3 Obtaining Topsoil.** Prior to the stripping of topsoil from designated areas, any vegetation, briars, stumps and large roots, rubbish or stones found on such areas, which may interfere with subsequent operations, shall be removed using methods approved by the ENGINEER. Heavy sod or other cover, which cannot be incorporated into the topsoil by discing or other means shall be removed.

When suitable topsoil is available on the site, the Contractor shall remove this material from the designated areas and to the depth as directed by the ENGINEER. The topsoil shall be spread on areas already tilled and smooth-graded or stockpiled in areas approved by the ENGINEER. Any topsoil stockpiled by the Contractor shall be rehandled and placed without additional compensation. Any topsoil that has been stockpiled on the site by others, and is required for topsoil purposes, shall be removed, and placed by the Contractor. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded if required and put into a condition acceptable for seeding.

When suitable topsoil is secured off the Airport site, the Contractor shall locate and obtain the supply, subject to the approval of the ENGINEER. The Contractor shall notify the ENGINEER sufficiently in advance of operations in order that necessary measurements and tests can be made. The Contractor shall remove the topsoil from approved areas and to the depth as directed. The topsoil shall be hauled to the site of the work and placed for spreading or spread as required. Any topsoil hauled to the site of the work and stockpiled shall be rehandled and placed without additional compensation.

**905-3.4 Placing Topsoil.** The topsoil shall be evenly spread on the prepared areas to a uniform depth of 3 inches after compaction, unless otherwise shown on the plans or stated in the special provisions. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition



detrimental to the work. Spreading shall be carried on so that turbing operations can proceed with a minimum of soil preparation or tilling.

After spreading, any large, stiff clods and hard lumps shall be broken with a pulverizer or by other effective means, and all stones or rocks (2 inches or more in diameter), roots, litter, or any foreign matter shall be raked up and disposed of by the Contractor. After spreading is completed, the topsoil shall be satisfactorily compacted by rolling with a cultipacker or by other means approved by the ENGINEER. The compacted topsoil surface shall conform to the required lines, grades, and cross-sections. Any topsoil or other dirt falling upon pavements as a result of hauling or handling of topsoil shall be promptly removed.

### **METHOD OF MEASUREMENT**

- 905-4.1** Topsoil obtained off the site shall be measured by the number of square yards of topsoil measured in its final position after it has been placed on the site. .

### **BASIS OF PAYMENT**

- 905-5.1** Payment will be made at the contract unit price per square yard for topsoil (obtained off the site). This price shall be full compensation for furnishing all materials and for all preparation, placing, and spreading of the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item T-905-5.1 3" of Topsoil (Furnished from Off the Site) – per Square Yard

### **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 C117	Materials Finer than 75 $\mu\text{m}$ (No. 200) Sieve in Mineral Aggregates by Washing
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#### **Advisory Circulars (AC)**

AC 150/5200-33C	Hazardous Wildlife Attractants on or Near Airports
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#### **FAA/United States Department of Agriculture**

Talbert & Bright

**Wildlife Hazard Management at Airports, A Manual for Airport Personnel**

**END OF ITEM T-905**

## **ITEM T-908**

### **MULCHING**

#### **DESCRIPTION**

- 908-1.1** This item shall consist of furnishing, hauling, placing, and securing mulch on surfaces indicated on the plans or designated by the ENGINEER.

#### **MATERIALS**

- 908-2.1 Mulch Material.** Acceptable mulch shall be the materials listed below or any approved locally available material that is similar to those specified. Mulch shall be free from noxious weeds, mold, and other deleterious materials. Mulch materials, which contain matured seed of species that would volunteer and be detrimental to the proposed over seeding, or to surrounding farm land, will not be acceptable. Straw or other mulch material which is fresh and/or excessively brittle, or which is in such an advanced stage of decomposition as to smother or retard the planted grass, will not be acceptable.

**A. Manufactured Mulch.** Cellulose-fiber or wood-pulp mulch shall be products commercially available for use in spray applications.

- 908-2.2 Inspection.** The ENGINEER shall be notified of sources and quantities of mulch materials available and the Contractor shall furnish him with representative samples of the materials to be used 30 days before delivery to the project. These samples may be used as standards with the approval of the ENGINEER and any materials brought on the site that do not meet these standards shall be rejected.

#### **CONSTRUCTION METHODS**

- 908-3.1 Mulching.** Before spreading mulch, all large clods, stumps, stones, brush, roots, and other foreign material shall be removed from the area to be mulched. Mulch shall be applied immediately after seeding. The spreading of the mulch may be by hand methods, blower, or other mechanical methods, provided a uniform covering is obtained.

Mulch material shall be furnished, hauled, and evenly applied on the area shown on the plans or designated by the ENGINEER. Mulch may be blown on the slopes and the use of cutters in the equipment for this purpose will be permitted to the extent that at least 95% of the mulch in place on the slope shall be 6 inches or more in length. When mulches applied by the blowing method are cut, the loose depth in place shall be not less than one inch nor more than 2 inches.

**908-3.2 Securing Mulch.** The mulch shall be held in place by light discing, a very thin covering of topsoil, pins, stakes, wire mesh, asphalt binder, or other adhesive material approved by the ENGINEER. Where mulches have been secured by either of the asphalt binder methods, it will not be permissible to walk on the slopes after the binder has been applied. When an application of asphalt binder material is used to secure the mulch, the Contractor must take every precaution to guard against damaging or disfiguring structures or property on or adjacent to the areas worked and will be held responsible for any such damage resulting from the operation.

If the “peg and string” method is used, the mulch shall be secured by the use of stakes or wire pins driven into the ground on 5-foot centers or less. Binder twine shall be strung between adjacent stakes in straight lines and crisscrossed diagonally over the mulch, after which the stakes shall be firmly driven nearly flush to the ground to draw the twine down tight onto the mulch.

**908-3.3 Care and Repair.**

**A.** The Contractor shall care for the mulched areas until final acceptance of the project. Care shall consist of providing protection against traffic or other use by placing warning signs, as approved by the ENGINEER, and erecting any barricades that may be shown on the plans before or immediately after mulching has been completed on the designated areas.

**B.** The Contractor shall be required to repair or replace any mulch that is defective or becomes damaged until the project is finally accepted. When, in the judgment of the ENGINEER, such defects or damages are the result of poor workmanship or failure to meet the requirements of the specifications, the cost of the necessary repairs or replacement shall be borne by the Contractor.

**C.** If the “asphalt spray” method is used, all mulched surfaces shall be sprayed with asphalt binder material so that the surface has a uniform appearance. The binder shall be uniformly applied to the mulch at the rate of approximately 8 gallons per 1,000 square feet, or as directed by the ENGINEER, with a minimum of 6 gallons and a maximum of 10 gallons per 1,000 square feet depending on the type of mulch and the effectiveness of the binder securing it. Asphalt binder material may be sprayed on the mulched slope areas from either the top or the bottom of the slope. An approved spray nozzle shall be used. The nozzle shall be operated at a distance of not less than 4 feet from the surface of the mulch and uniform distribution of the asphalt material shall be required. A pump or an air compressor of adequate capacity shall be used to ensure uniform distribution of the asphalt material.

**D.** If the “asphalt mix” method is used, the mulch shall be applied by blowing, and the asphalt binder material shall be sprayed into the mulch as it leaves the blower. The binder shall be uniformly applied to the mulch at the rate of

approximately 8 gallons per 1,000 square feet or as directed by the ENGINEER, with a minimum of 6 gallons and a maximum of 10 gallons per 1,000 square feet depending on the type of mulch and the effectiveness of the binder securing it.

## METHOD OF MEASUREMENT

- 908-4.1** Mulching shall be measured in acres on the basis of the actual surface area acceptably mulched.

## BASIS OF PAYMENT

- 908-5.1** Payment will be made at the contract unit price per acre for mulching. The price shall be full compensation for furnishing all materials and for placing and anchoring the materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item T-908-5.1 Mulching – per Acre

## 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 D977 Standard Specification for Emulsified Asphalt

## Advisory Circulars (AC)

AC 150/5200-33C Hazardous Wildlife Attractants on or Near Airports

**FAA/United States Department of Agriculture**

# Wildlife Hazard Management at Airports, A Manual for Airport Personnel

**END OF ITEM T-908**

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