

SECTION 02911

SOIL PREPARATION

PART 1 - GENERAL

1.01 SEQUENCING AND SCHEDULING

- A. Rough grade areas to be planted or seeded prior to performing Work specified under this Section.

1.02 APPLICABLE STANDARDS AND SPECIFICATIONS

- A. Comply with the following standards and specifications for all materials, methods, and workmanship unless otherwise noted:
 - 1. Florida Department of Transportation Standard Specifications for Road and Bridge Construction, current edition.
 - 2. City of Fort Lauderdale Code of Ordinances.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. General: Uniform mixture of 50 percent sand and 50 percent muck in a loose friable condition, free from objects larger than 1-1/2 inches maximum dimension, and free of subsoil, roots, grass, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.
- B. Textural Amendments: Amend as necessary to conform to required composition.
- C. Source: Import topsoil if onsite material fails to meet specified requirements or is insufficient in quantity.

2.02 SOURCE QUALITY CONTROL

- A. Topsoil Analysis/Testing: Performed by county or state soil testing service or approved certified independent testing laboratory.
- B. Should soil tests prove the topsoil to alkaline or above the accepted minimum for salt content, the topsoil shall be removed and replaced by acceptable material at Contractor's expense.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

- A. The subgrade shall be 4 inches lower than finished grade with 2 inches of topsoil added to sod areas.

- B. Scarify subgrade to minimum depth of 6 inches where topsoil is to be placed.
- C. Remove stones over 2-1/2 inches in any dimension, sticks, roots, rubbish, and other extraneous material.
- D. Limit preparation to areas which will receive topsoil within 2 days after preparation.

3.02 TOPSOIL PLACEMENT

- A. Topsoil Thickness:
 - 1. Sodded Areas: 2 inches.
 - 2. Planting Beds: 6 inches.
- B. Do not place topsoil when subsoil or topsoil is excessively wet or otherwise detrimental to the Work.
- C. Mix soil amendments with topsoil before placement or spread on topsoil surface and mix thoroughly into entire depth of topsoil before planting or seeding.
- D. Uniformly distribute to within 1/2-inch of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade.
- E. Remove stones exceeding 1-1/2 inches, roots, sticks, debris, and foreign matter during and after topsoil placement.
- F. Remove surplus subsoil and topsoil from site. Grade stockpile area as necessary and place in condition acceptable for planting or seeding.

- END OF SECTION -

SECTION 02920

SODDING

PART 1 - GENERAL

1.01 DEFINITIONS

- A. Maintenance Period: Begin maintenance immediately after each area is planted (sod) and continue for a period of 8 weeks after all planting under this Section is completed.
- B. Satisfactory Stand:
 - 1. Grass or section of grass that has:
 - a. No bare spots larger than 3 square feet.
 - b. Not more than 10 percent of total area with bare spots larger than 1 square foot.
 - c. Not more than 15 percent of total area with bare spots larger than 6 square inches.

1.02 DELIVERY, STORAGE, AND PROTECTION

- A. Sod:
 - 1. Do not harvest if sod is excessively dry or wet to the extent survival may be adversely affected.
 - 2. Harvest and deliver sod only after laying bed is prepared for sodding.
 - 3. Roll or stack to prevent yellowing.
 - 4. Deliver and lay within 24 hours of harvesting.
 - 5. Keep moist and covered to protect from drying from time of harvesting until laid.

1.03 WEATHER RESTRICTIONS

- A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.04 SEQUENCING AND SCHEDULING

- A. Prepare topsoil as specified in the Contract Documents, before starting Work of this Section.
- B. Complete Work under this section within ten (10) days following completion of soil preparation.
- C. Notify City at least three (3) days in advance of:
 - 1. Each material delivery.

2. Start of planting activity.

D. Planting Season: Those times of year that are normal for such Work as determined by accepted local practice. At a minimum, Contractor shall avoid planting in January or February.

1.05 MAINTENANCE SERVICE

A. Contractor: Perform maintenance operations during maintenance period to include:

1. Watering: Keep surface moist.
2. Washouts: Repair by filling with topsoil, and replace sodded areas.
3. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3 1/2 inches.
4. Re-sod unsatisfactory areas or portions thereof immediately at the end of the maintenance period if a satisfactory stand has not been produced, at which time maintenance period shall recommence.
5. Re-sod during next planting season if scheduled end of maintenance period falls after September 15.

PART 2 - MATERIALS

2.01 FERTILIZER

A. Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose. Minimum percentage of plant food by weight.

B. Mix:

1. Nitrogen: Sixteen.
2. Phosphoric Acid: Four.
3. Potash: Eight.

2.02 SOD

A. Unless a particular type of sod is called for, sod may be of either St. Augustine Floritam, Bahia grass or Seashore Paspalum, in accordance with the following:

1. Use Bahia grass where no irrigation system exists.
2. Use St. Augustine Floritam where an irrigation system is in place. If original sod being replaced is St. Augustine Floritam, replacement sod shall match.
3. Seashore Paspalum sod will be used in areas prone to salt water flooding.

B. Strongly rooted pads, capable of supporting own weight and retaining size and shape when suspended vertically from a firm grasp on upper 10 percent of pad.

1. Grass Height: Normal.

2. Strip Size: Supplier's standard, commercial size rectangles.
3. Soil Thickness: Uniform; 1-inch plus or minus 1/4-inch at time of cutting.
4. Age: Not less than 10 months or more than 30 months.
5. Condition: Healthy, green, moist; free of diseases, nematodes and insects, and of undesirable grassy and broadleaf weeds. Yellow sod, or broken pads, or torn or uneven ends will not be accepted
6. Any netting contained within the sod shall be certified by the manufacturer to be bio-degradable within a period of 3 months from installation.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Grade Areas to Smooth, Even Surface with Loose, Uniformly Fine Texture:
 1. Roll and rake, remove ridges, fill depressions to meet finish grades.
 2. Limit such Work to areas to be planted within immediate future.
 3. Remove debris, foreign material and stones larger than 1 1/2 inches diameter, and other objects that may interfere with planting and maintenance operations.
- B. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before seeding. Do not create muddy soil.
- C. Restore prepared areas to specified condition if eroded or otherwise disturbed after preparation and before planting.
- D. Limit preparation to those areas that can be sodded within 72 hours after preparation.

3.02 FERTILIZER

- A. Apply evenly over area in accordance with manufacturer's instructions. Mix into top 2 inches of top soil.
- B. Application Rate: 20 pounds per 1,000 square feet (1,000 pounds per acre).

3.03 SODDING

- A. Do not plant dormant sod, or when soil conditions are unsuitable for proper results.
- B. Pre-wet the area prior to placing sod. Lay sod to form solid mass with tightly fitted joints; butt ends and sides, do not overlap:
 1. Stagger strips to offset joints in adjacent courses.
 2. Work from boards to avoid damage to subgrade or sod.
 3. Tamp or roll lightly to ensure contact with subgrade; work sifted soil into minor cracks between pieces of sod, remove excess to avoid smothering adjacent grass.

4. Complete sod surface true to finished grade, even, and firm.
- C. Fasten sod on slopes to prevent slippage with wooden pins 6 inches long driven through sod into subgrade, until flush with top of sod. Install at sufficiently close intervals to securely hold sod.
- D. Water sod with fine spray immediately after planting. During first month, water daily or as required to maintain moist soil to depth of 4 inches.

3.04 FIELD QUALITY CONTROL

- A. Eight weeks after sodding is complete and on written notice from Contractor, City will, within 15 days of receipt, determine if the sod has been satisfactorily established.
- B. If the sod is not satisfactorily established, Contractor shall replace the sod and repeat the requirements of this Section.

- END OF SECTION -

SECTION 03100
CONCRETE FORMWORK

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall design and furnish all materials for concrete formwork, bracing, and supports and shall design and construct all falsework, all in accordance with the provisions of the Contract Documents.

1.02 RESPONSIBILITY

- A. The design and engineering of the formwork as well as safety considerations are the responsibility of the Contractor.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03200 - Concrete Reinforcement
- C. Section 03300 - Cast in Place Concrete
- D. Section 03315 - Grout

1.04 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
 - 1. Codes and Standards
 - a. The Building Code, as referenced herein, is the Florida Building Code (FBC).
 - 2. Government Standards
 - a. PS 1U.S. Product Standard for Concrete Forms, Class I.
 - 3. Commercial Standards
 - a. ACI 347 Recommended Practice for Concrete Formwork.
 - b. ACI 318R Building Code Requirements for Reinforced Concrete.
 - c. ACI 350 Code Requirements for Environmental Engineering Concrete Structures

1.05 QUALITY ASSURANCE

- A. The variation from established grade or lines shall not exceed 1/4 inch in 10 feet and there shall be no offsets or visible bulges or waviness in the finished surface. All tolerances shall be within the "Suggested Tolerances" specified in ACI 347. The Contractor shall grind smooth all fins and projections between formwork panels as directed by the Engineer.
- B. Curved forms shall be used for curved and circular structures that are cast-in-place. Straight panels will not be acceptable for forming curved structures.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

- A. Except as otherwise expressly accepted by the Engineer, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material. All forms shall be smooth surface forms and shall be of the following materials:
 - 1. Footing sides - Construction grade Southern Pine or Douglas Fir
 - 2. Walls - Steel or plywood panel
 - 3. Columns - Steel, plywood or fiber glass
 - 4. Roof and floor Slabs - Plywood
 - 5. All other work - Steel panels, plywood or tongue and groove lumber
- B. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
 - 1. Lumber shall be Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.
 - 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS I for Concrete Forms, Class I, and shall be edge sealed. Thickness shall be as required to support concrete at the rate it is placed, but not less than 5/8 inch thick.

2.02 PREFABRICATED FORMS

- A. Form materials shall be metal, wood, plywood, or other acceptable material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall be an acceptable type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

2.03 FORMWORK ACCESSORIES

- A. Exterior corners in concrete members shall be provided with 3/4 inch chamfers. Reentrant corners in concrete members shall not have fillets unless otherwise shown.

- B. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties, or of other removable form tie fasteners having a circular cross section, shall not exceed 1 1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming.
- C. Form ties for water-retaining structures shall have integral waterstops. Removable taper ties may be used when acceptable to the Engineer. At locations where removable taper ties are acceptable, a preformed mechanical EPDM rubber plug shall be used to seal the hole left after the removal of the taper tie. Plug shall be X-Plug by the Greenstreak Group, Inc., or approved equal. Friction fit plugs shall not be used.
- D. Form release agent shall be a blend of natural and synthetic chemicals that employs a chemical reaction to provide quick, easy and clean release of concrete from forms. It shall not stain the concrete and shall leave the concrete with a paintable surface. Formulation of the form release agent shall be such that it would minimize formation of "Bug Holes" in cast-in-place concrete.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the Work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms and falsework, shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- B. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantially, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete.
- C. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8 inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete.

Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1 to 1 1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean outs shall be as acceptable to the Engineer.

- D. Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory affect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

3.02 EARTH FORMS

- A. All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is called for on the Drawings. Not less than 1 inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Such permission will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

3.03 FOOTINGS, SLAB EDGES AND GRADE BEAMS

- A. Provide wood side forms for all footings, slab edges and grade beams.

3.04 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.05 INSERTS, EMBEDDED PARTS AND OPENINGS

- A. Embedded Form Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as specified for in Section 03350 entitled "Concrete Finishes". Wire ties for holding forms will not be permitted. No form tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1 inch back from the formed face or faces of the concrete.

3.06 FORM CLEANING

- A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are

defined as surfaces which are permanently exposed to view. Unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

3.07 FORMWORK TOLERANCES

- A. Formwork shall be constructed to insure that finished concrete surfaces will be in accordance with the tolerances listed in ACI 347.
 - 1. The following construction tolerances are hereby established and apply to finished walls and slab unless otherwise shown in the Drawings:

Item	Tolerance
Variation of the constructed linear outline from the established position in plan	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the level or from the grades shown on the Drawings	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation from the plumb	In 10 feet: 1/4 inch; In 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls	Minus 1/4 inch; Plus 1/2 inch
Variation in the locations and sizes of slab and wall openings	Plus or minus 1/4 inch

3.08 FORM REMOVAL

- A. Remove top forms on sloping surfaces of concrete as soon as removal operations will not allow the concrete to sag. Perform any needed repairs or treatments required on sloping surfaces at once, and follow immediately with the specified curing.
- B. The Contractor shall be responsible for the removal of forms and shores. Forms or shores shall not be removed before test cylinders have reached the specified minimum 28 day compressive strength for the class of concrete specified in Section 03300 entitled "Cast-in-Place Concrete", nor sooner than listed below:
 - 1. Grade beam side forms: 3 days
 - 2. Wall forms: 3 days
 - 3. Column forms: 3 days
 - 4. Beam and girder side forms: 3 days
 - 5. Beam bottoms and slab forms/shores: 14 days

3.09 MAINTENANCE OF FORMS

- A. Forms shall be maintained at all times in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Forms, when in place, shall conform to the established alignment and grades. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining

mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the Contractor shall perform the oiling at least two weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, fabricate and place all concrete reinforcing steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and shall perform all appurtenant work, including all the wires, clips, supports, chairs, spacers, and other accessories and special work necessary to hold the reinforcing steel in place and protect it from injury and corrosion, all in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03100 - Concrete Formwork
- C. Section 03300 - Cast in Place Concrete
- D. Section 03315 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these specifications, all Work specified herein shall conform to or exceed the requirements of the Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
 - 1. Codes and Standards
 - a. The Building Code, as referenced herein, is the Florida Building Code (FBC).
 - 2. Commercial Standards
 - a. ACI 315 Details and Detailing of Concrete Reinforcement.
 - b. CRSI Concrete Reinforcing Steel Institute Manual of Standard Practice
 - c. ACI SP66 ACI Detailing Manual
 - d. ACI 305 Hot Weather Concreting
 - e. ACI 318 Building Code Requirements for Reinforced Concrete.
 - f. ACI 350 Code Requirements for Environmental Engineering Concrete Structures
 - g. WRI Manual of Standard Practice for Welded Wire Fabric.

- h. ASTM A 1064 Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- i. ASTM A 615 Specification for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

1.04 SUBMITTALS

- A. The Contractor shall furnish shop bending diagrams, placing lists, and Drawings of all reinforcing steel prior to fabrication in accordance with the requirements of the Section 01300 entitled, "Submittals." The Contractor shall submit detailed placing and shop fabricating drawings, prepared in accordance with ACI 315 and ACI Detailing Manual - (SP66) for all reinforcing steel. These drawings shall be made to such a scale as to clearly show joint locations, openings, the arrangement, spacing and splicing of the bars. Where opening sizes are dependent on equipment selection the Contractor shall indicate all necessary dimensions to define steel lengths and placing details.
- B. Details of the concrete reinforcing steel and concrete inserts shall be submitted by the Contractor at the earliest possible date after receipt by the Contractor of the Notice to Proceed. Said details of reinforcing steel for fabrication and erection shall conform to ACI 315 and the requirements specified and shown. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop Drawings shall include bar placement diagrams which clearly indicate the dimensions of each bar splice.
- C. Where mechanical couplers are shown on the Drawings to be used to splice reinforcing steel, the Contractor shall submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop Drawings which show the location of each coupler with details of how they are to be installed in the formwork.
- D. Requests to relocate any bars that cause interferences or that cause placing tolerances to be violated.
- E. Proposed supports for each type of reinforcing.
- F. Certification that all installers of dowel adhesives are certified as Adhesive Anchor Installers in accordance with the ACI-CRSI Anchor Installer Certification Program.
- G. International Code Council-Evaluation Services Evaluation Services Report (ICC-ES ESR) for dowel adhesives.
- H. Adhesive dowel testing plan.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications for Drilled-In Rebar: Drilled-in rebar shall be installed by an Installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.

- B. Installer Training: Conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process for drilled-in anchors, to include but not be limited to the following:
1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Rebar doweling preparation and installation.
 5. Proof loading/torquing.
- C. Inspections of the adhesive dowel system may be made by the Engineer or other representatives of the City in accordance with the requirements of the ESR published by the manufacturer. Provide adequate time and access for inspection of products and anchor holes prior to injection, installation, and proof testing.

PART 2 - PRODUCTS

2.01 REINFORCEMENT

- A. All reinforcing steel for all reinforced concrete construction shall conform to the following requirements:
1. Bar reinforcement shall conform to the requirements of ASTM A 615 for Grade 60 Billet Steel Reinforcement, and shall be manufactured in the United States. All reinforcing steel shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type and grade. All reinforcing bars shall be deformed bars. Smooth reinforcing bars shall not be used unless specifically called for on the Drawings.
 2. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 1064 and the details shown on the Drawings; provided, that welded wire fabric with longitudinal wire of W9.5 size wire shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W9.5 size shall be furnished in flat sheets only. All welded wire fabric reinforcement shall be galvanized.
- B. Field welding of reinforcing steel will not be allowed.
- C. Use of coiled reinforcing steel will not be allowed.

2.02 ACCESSORY MATERIALS

- A. Bolsters, chairs, spacers and other devices for supporting and fastening reinforcing in place shall be plastic protected wire bars supports complying with CRSI recommendations conforming to Class 1 bar supports.
- B. Metal bar supports for reinforcing steel for wastewater structures shall be Class 2, Type B stainless steel protected bar supports (CRSI).

- C. Tie Wire: Galvanized 16 gauge annealed type.
- D. Concrete blocks (dobies), used to support and position reinforcing steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Concrete blocks shall only be used bottom mat of reinforcing steel for slabs on grade.

2.03 MECHANICAL COUPLERS

- A. Mechanical couplers shall develop a tensile strength which exceeds 100 percent of the ultimate tensile strength and 125 percent of the yield strength of the reinforcing bars being spliced. The reinforcing steel and coupler used shall be compatible for obtaining the required strength of the connection.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied.
- C. Hot forged sleeve type couplers shall not be used. Acceptable mechanical couplers are Dayton Superior Dowel Bar Splicer System by Dayton Superior, Dayton, Ohio, or approved equal. Mechanical couplers shall only be used where shown on the Drawings or where specifically approved by the Engineer.
- D. Where the threaded rebar to be inserted into the coupler reduces the diameter of the bar, the threaded rebar piece shall be provided by the coupler manufacturer.

2.04 DOWEL ADHESIVE SYSTEM

- A. Where shown on the Drawings, reinforcing bars anchored into hardened concrete with a dowel adhesive system shall use a two-component adhesive mix which shall be injected with a static mixing nozzle following manufacturer's instructions.
- B. All holes shall be drilled with a carbide bit unless otherwise recommended by the manufacturer. If coring holes is allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements.
- C. Thoroughly clean drill holes of all debris, drill dust, and water in accordance with manufacturer's instructions with compressed air and a wire brush prior to installation of adhesive and reinforcing bar.
- D. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Installation conditions shall be either dry or water-saturated. Water filled or submerged holes shall not be permitted unless specifically approved by the Engineer.
- E. Injection of adhesive into the hole shall be performed in a manner to minimize the formation of air pockets in accordance with the manufacturer's instructions.
- F. Embedment Depth:
 - 1. The embedment depth of the bar shall be as show on the Drawings. Although all manufacturers listed below are permitted, the embedment depth shown on the Drawings is based on "SET-XP" by Simpson Strong-Tie Co. If the Contractor submits one of the other named dowel adhesives from the list below, the Engineer

shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.

2. Where the embedment depth is not shown on the Drawings, the embedment depth shall be determined to provide the minimum allowable bond strength equal to the tensile strength of the rebar according to the manufacturer's ICC-ES ESR.
 3. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum, or more than the maximum, embedment depths stated in the manufacturer's ICC-ES ESR.
- G. Engineer's approval is required for use of this system in locations other than those shown on the Drawings.
- H. The adhesive system shall be IBC compliant for use in both cracked and uncracked concrete, must comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report. The adhesive system shall be "Epcon System C6+ Adhesive Anchoring System" as manufactured by ITW Redhead, "HIT-HY 200 Injection Adhesive Anchor System" as manufactured by Hilti, Inc. "SET-XP" as manufactured by Simpson Strong-Tie Co. or "Pure 110+ Epoxy Adhesive Anchor System" by Powers Fasteners. Fast-set epoxy formulations shall not be acceptable.
- I. All individuals installing dowel adhesive system shall be certified as an Adhesive Anchor Installer in accordance with the ACI-CRSI Anchor Installation Certification Program.

2.05 FABRICATION

- A. Reinforcing steel shall be accurately formed to the dimensions and shapes shown on the Drawings, and the fabricating details shall be prepared in accordance with ACI 315 and ACII 318, except as modified by the Drawings. Stirrups and tie bars shall be bent around a pin having a diameter not less than 1 1/2 inch for No. 3 bars, 2 inch for No. 4 bars, and 2 1/2 inch for No. 5 bars. Bends for other bars shall be made around a pin having a diameter not less than 6 times the minimum thickness, except for bars larger than 1 inch, in which case the bends shall be made around a pin of 8 bar diameters. Bars shall be bent cold.
- B. The Contractor shall fabricate reinforcing bars for structures in accordance with bending diagrams, placing lists, and placing Drawings. Said Drawings, diagrams, and lists shall be prepared by the Contractor as specified under Section entitled "Submittals," herein.
- C. Fabricating Tolerances: Bars used for concrete reinforcing shall meet the following requirements for fabricating tolerances:
1. Sheared length: + 1 inch
 2. Depth of truss bars: + 0, 1/2 inch
 3. Stirrups and ties: + 1/2 inch

4. All other bends: + 1 inch

2.06 MINIMUM REINFORCEMENT

- A. Unless otherwise shown on the Drawings or in the absence of the steel being shown, the minimum cross sectional area of reinforcing steel in the direction of principal reinforcement shall be 0.0033 times the gross concrete area of all concrete members.
- B. Unless otherwise shown on the Drawings or in the absence of the steel being shown, the minimum cross sectional area of temperature reinforcing steel (reinforcing steel perpendicular to the principal reinforcing steel) shall be as follows:
 1. 0.0020 times the gross concrete area in slabs of non-water-bearing structures.
 2. 0.0015 times the gross concrete area vertically in walls of non-water-bearing structures.
 3. 0.0025 times the gross concrete area horizontally in walls of non-water-bearing structures.
 4. 0.0050 times the gross concrete area in slabs of water-bearing structures
 5. 0.0030 times the gross concrete area vertically in walls of water-bearing structures.
 6. 0.0050 times the gross concrete area horizontally in walls of water-bearing structures.
 7. Temperature steel shall not be spaced further apart than five times the slab or wall thickness, nor more than 18 inches.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

- A. All reinforcing shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.
- B. Reinforcing steel shall be stored above ground on platforms or other supports and shall be protected from the weather at all times by suitable covering. It shall be stored in an orderly manner and plainly marked to facilitate identification.
- C. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- D. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and if necessary recleaned.

3.02 PLACEMENT

- A. Reinforcing steel shall be accurately positioned as shown on the Drawings, and shall be supported and wired together to prevent displacement, using annealed iron wire ties

or suitable clips at intersections. All reinforcing steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcing steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcing steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.

- B. The portions of all accessories in contact with the formwork shall be made of plastic or steel coated with a 1/8 inch minimum thickness of plastic which extends at least 1/2 inch from the concrete surface. Plastic shall be gray in color.
- C. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- D. Bars additional to those shown on the Drawings which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at its own expense.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in Section 7.5 of ACI 318 except where in conflict with the requirements of the Building Code.
- F. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be as acceptable to the Engineer.
- G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic coated standard type legs as specified in Paragraph B herein. Slab bolsters shall be spaced not less than 30 inches on centers, shall extend continuously across the entire width of the reinforcing mat, and shall support the reinforcing mat in the plane shown on the Drawings.
- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobbies) spaced not more than 3 feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.
- I. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars nor less than 1 1/3 times the maximum size of the coarse aggregate, nor less than one inch.
- J. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.
- K. In columns, the clear distance between longitudinal bars shall be not less than 1 1/2 times the bar diameter, nor less than 1 1/2 times the maximum size of the coarse aggregate, nor less than 1 1/2 inches.

- L. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.
- M. Reinforcing bar splices shall only be used at locations shown on the Drawings. When it is necessary to splice reinforcement at points other than where shown, the character of the splice shall be as acceptable to the Engineer.
- N. The length of lap for reinforcing bars, unless otherwise shown on the Drawings shall be in accordance with ACI 318, Section 12.15.1 for a class B splice.
- O. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.
- P. Couplers which are located at a joint face shall be a type which can be set either flush or recessed from the face as shown on the Drawings. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. After the concrete is placed, couplers intended for future connections shall be plugged and sealed to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged with plastic plugs which have an O-ring seal.
- Q. Reinforcing shall not be straightened or rebent in a manner which will injure the material. Bars with kinks or bends not shown on the Drawings shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. No bars partially embedded in concrete shall be field bent except as shown on the Drawings or specifically permitted by the Engineer.
- R. Dowel Adhesive System shall be installed in strict conformance with the manufacturer's recommendations and as required in Article 2.04 above. A representative of the manufacturer must be on site prior to adhesive dowel installation to provide instruction on proper installation procedures for all adhesive dowel installers. Testing of adhesive dowels shall be as indicated below. If the dowels have a hook at the end to be embedded in subsequent work, an approved mechanical coupler shall be provided at a convenient distance from the face of existing concrete to facilitate adhesive dowel testing while maintaining required hook embedment in subsequent work.
- S. Adhesive Dowel Testing
 - 1. At all locations where adhesive dowels are shown on the Drawings, at least 5 percent of all adhesive dowels installed shall be tested to the value indicated on the Drawings, with a minimum of one tested dowel per group. If no test value is indicated on the Drawings but the installed dowel is under direct tension, the Contractor shall notify the Engineer to verify the required test value.
 - 2. Contractor shall submit a plan and schedule indicating locations of dowels to be tested, load test values and proposed dowel testing procedure (including a diagram of the testing equipment proposed for use) prior to conducting any testing. The testing equipment shall have a minimum of three support points and shall be of sufficient size to locate the edge of supports no closer than two times the anchor embedment depth from the center of the anchor.
 - 3. Where Contract Documents indicate adhesive dowel design is the Contractor's responsibility, the Contractor shall submit a plan and schedule indicating locations

of dowels to be tested and load test values, sealed by a Professional Engineer currently registered in the State of Florida. The Contractor shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable.

4. Adhesive Dowel shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the dowel after loading shall be considered a failure. Dowels exhibiting damage shall be removed and replaced. If more than 5 percent of tested dowels fail, then 100 percent of dowels shall be proof tested.
5. Proof testing of adhesive dowels shall be performed by an independent testing laboratory hired directly by the Contractor. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.

3.03 CLEANING AND PROTECTION

- A. Reinforcing steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of all reinforcing steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary recleaned.

END OF SECTION

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SECTION 03290
JOINTS IN CONCRETE

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall construct all joints in concrete at the locations shown on the Drawings. Joints required in concrete structures are of various types and will be permitted only where shown on the Drawings, unless specifically accepted by the Engineer.
- B. Construction joints, expansion joints, contraction joints and control joints shall be provided at the locations shown and formed in accordance with the details shown on the Drawings.
- C. Waterstops shall be provided where shown on the Drawings, and in all waterbearing joints in hydraulic structures.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03200 - Concrete Reinforcement
- C. Section 03300 - Cast in Place Concrete.
- D. Section 03315 - Grout
- E. Section 03350 - Concrete Finishes
- F. Section 03370 - Concrete Curing

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the applicable requirements of the following documents to the extent that the provisions therein are not in conflict with the requirements of this Section.
 - 1. Federal Specifications:
 - a. TT S 00227E(3) Sealing Compound, Elastomeric Type, Multi component (For Caulking, Sealing, And Glazing Buildings And Other Structures).
 - 2. U.S. Army Corps of Engineers Standard Specifications
 - a. CRD C572
 - 3. Commercial Standards:
 - a. ASTM C 920 Specification for Elastomeric Joint Sealants.

- b. ASTM D 624 Test Method for Rubber Property Tear Resistance.
- c. ASTM D 638 Test Method for Tensile Properties of Plastics.
- d. ASTM D 746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- e. ASTM D 747 Test Method for Apparent Bending Modules of Plastics by Means of a Cantilever Beam.
- f. ASTM D 1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- g. ASTM D 2240 Test Method for Rubber Property Durometer Hardness.

1.04 TYPES OF JOINTS

- A. Construction Joints: When fresh concrete is placed against a hardened concrete surface, the joint between the two pours is called construction joint. Unless noted otherwise, all joints in water bearing structures shall be provided with a waterstop of the shape specified herein or shown on the Drawings.
- B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker. The slab reinforcement shall be stopped 4 1/2 inches from the joint; which is provided with a sleeve type dowel, to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided when specified on the Drawings.
- C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours, the joint shall be formed as detailed on the Drawings. This space is obtained by placing a preformed joint filler against the first pour, which acts as a form for the second pour. Unless noted otherwise, all expansion joints in water bearing members shall be provided with a 9-inch wide waterstop. Preformed joint filler shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material. The space so formed shall be filled with a joint sealant material as specified herein. The joint sealant shall be isolated from the filler using a bond breaker.
- D. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks will probably occur. A groove, of the shape and dimensions shown on the Drawing, is formed or saw cut in the concrete. This groove shall be filled with a joint sealant.

1.05 SUBMITTALS

- A. Waterstops: Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be furnished under this contract. The balance of the material to be used under this contract shall not

be produced until after the Engineer has reviewed the qualification samples. The samples shall be delivered to a location on site indicated by the Engineer.

- B. Joint Sealant: Prior to ordering the sealant material, the Contractor shall submit to the Engineer for the Engineer's review, sufficient data to show general compliance with the requirements of the Contract Documents.
- C. Contractor shall submit product data sheets of all materials proposed under this section.
- D. Shipping Certification: The Contractor shall provide written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents. Contractor certificates are not acceptable.
- E. The Contractor shall submit placement Shop Drawings showing the location and type of all joints for each structure.

1.06 QUALITY ASSURANCE

A. Waterstop

1. Review: It is required that all waterstop field joints shall be subject to review inspection, and no such work shall be scheduled or started without having made prior arrangements with the Engineer to provide for the required reviews. Not less than 24 hours' notice shall be provided to the Engineer for scheduling such reviews.
2. All field joints in waterstops will be subject to rigid review for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said review, and all faulty material shall be removed from the site and disposed of by the Contractor at its own expense.
3. The following defects represent a partial list of defects which shall be grounds for rejection:
 - a. Offsets at joints greater than 1/16 inch or 15 percent material thickness, at any point, whichever is less.
 - b. Exterior crack at joint, due to incomplete bond, deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
 - c. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16 inch or 15 percent of material thickness at any point, whichever is less.
 - d. Misalignment of joint which result in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
 - e. Porosity in the welded joint as evidenced by visual inspection.

- f. Bubbles or inadequate bonding which can be detected with pen knife test. (If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)

1.07 GUARANTEE

- A. The Contractor shall provide a two year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the City, at no additional cost to the City, any such defective areas which become evident within said two year guarantee period.

PART 2 - PRODUCTS

2.01 PVC WATERSTOPS

- A. General: Waterstops shall be extruded from an elastomeric polyvinylchloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used. The Contractor shall obtain from the waterstop manufacturer and shall furnish to the Engineer for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD C572 and listed in Paragraph C. below.
- B. Multi Rib Waterstops: All PVC waterstops shall be of Multi rib construction. Waterstops for construction joints shall be serrated style 732 by Greenstreak or equal. Waterstops for expansion joints shall be Style 738 by Greenstreak or equal. T type waterstops installed against existing concrete shall be Style 609 by Greenstreak, or equal. Compatible baten bars and anchor bolts shall be supplied by the same manufacturer. Prefabricated joint fittings (90° bends and tees) shall be used at all intersections of the ribbed type waterstops.
- C. Waterstop Testing Requirements: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

	Value	ASTM Std.
Tensile Strength-min (psi)	1750	D 638, Type IV
Ultimate Elongation-min (percent)	350	D 638, Type IV
Low Temp. Brittleness-Max (degrees F)	-35	D 746
Stiffness in Flexure-min (psi)	400	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min (psi)	1500	D 638, Type IV
Ultimate Elongation-min (percent)	300	D 638, Type IV
Effect of Alkalies (CRD-C572)		
Ultimate Elongation-min (percent)	300	D 638, Type IV

	Value	ASTM Std.
Change in Weight (percent)	+0.25/-0.10	----
Change in Durometer, Shore A	+5	D 2240
<u>Finish Waterstop</u>		
Tensile Strength-min (psi)	1400	D 638, Type IV
Ultimate Elongation-min (percent)	280	D 638, Type IV

2.02 CHEMICAL RESISTANT WATERSTOPS

- A. **General:** Waterstops shall be manufactured from thermoplastic elastomeric rubber material. The synthetic rubber shall be provide a high resistance to acids, bases, alcohols, oils, solvents or chemicals. No reclaimed material shall be used. The Contractor shall obtain from the waterstop manufacturer and furnish to the Engineer for review, current test reports and a written certification of the manufacturer that the material to be shipped to the job meets the physical requirements outlined herein. Waterstop connections shall be heat welded. All waterstop corners, intersections, and directional changes shall be miter cut, heat welded, factory fabricated. Only straight butt splices shall be allowed in the field.
- B. **Multi-Rib Waterstops:** All chemical resistant waterstops shall be of multi-rib construction. Waterstops for expansion joints shall be 9"x3/16" ribbed with a center bulb. Waterstops for construction joints shall be 6"x3/16" ribbed with a center bulb. Chemical resistant waterstops shall be Westec Type TPE-R synthetic rubber, manufactured by Westec Barrier Technologies, St. Louis, MO, or equal.
- C. **Waterstop Physical Properties:** When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property	Value	ASTM Std.
Tensile Strength	1800 psi	D-412
Ultimate Elongation	450%	D-412
100% Modulus	1000 psi	D-412
Shore A Hardness	85 units \pm 5 units	D-2240
Brittle Point	-70°F	D-746
Ozone Resistance	450 pphm passed	D-1171

- A. **Weathering Performance:** When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property	Value	ASTM Std.
Tensile Strength (% Retention)	87%	D-412
Ultimate Elongation (% Retention)	84%	D-412
Shore A Hardness (units change)	7 units	D-2240

D. Chemical Resistance Properties: When tested in accordance with ASTM D-471 after 166 hours of full immersion at 73.4oF (23oC), the waterstop material shall meet or exceed the following requirements:

Fluid	Physical Property	Value
Sulfuric Acid 98%	Ultimate Elongation	77% Retention
	Ultimate Tensile	82% Retention
	100% Modulus	108% Retention
	Hardness Change Shore A	-1 Unit
	Weight Change	2.1%
Sodium Hydroxide 50%	Ultimate Elongation	101% Retention
	Ultimate Tensile	107% Retention
	100% Modulus	104% Retention
	Hardness Change Shore A	-4 Unit
	Weight Change	-0.1%

2.03 HYDROPHILIC WATERSTOPS

- A. Hydrophilic waterstops shall be designed to expand and seal under hydrostatic conditions. At construction joints, the waterstops shall be Adeka Ultraseal MC 2010 M for wall/slab thickness greater than 9 inches, and Adeka Ultraseal KBA-1510FF for wall/slab thickness less than 9 inches or equal. At expansion joints, the waterstops shall be Adeka Ultraseal KM-3030M or equal.
- B. Plate fabrications used to plug flow channels for future expansion or otherwise to close wall openings shall be caulked using hydrophilic waterstops designed for the application. Caulking agents shall be Adeka Ultraseal P201 or equal.

2.04 JOINT SEALANT

- A. Joint sealant shall comply with Section 07920 entitled “Sealants and Caulking”.

2.05 EXPANSION JOINT MATERIAL

- A. Preformed expansion joint material shall be non-extruding, and shall be one of the following types:
 1. Type I – Sponge rubber, conforming to ASTM D1752, Type I
 2. Type II – Cork, conforming to ASTM D1752, Type II
 3. Type III – Self-expanding cork, conforming to ASTM D1752, Type III
 4. Type IV – Bituminous fiber, conforming to ASTM Designation D1752

2.06 BACKER ROD

- A. Backer rod shall comply with Section 07920 entitled “Sealants and Caulking”.

2.07 BOND BREAKER

- A. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Hunt Process 225 TU as manufactured by Hunt Process Co., Santa Fe Springs, CA; Select Cure CRB as manufactured by Select Products Co., Upland, CA; or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable.

2.08 CONTRACTION JOINT INSERTS

- A. Contraction joint inserts shall be Transverse-Control Joints by Greenstreak Plastic Products or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Unless otherwise shown on the Drawings, waterstops of the type specified herein shall be embedded in the concrete across joints as shown. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The Contractor shall take suitable precautions and means to support and protect the waterstops during the progress of the Work and shall repair or replace at its own expense any waterstops damaged during the progress of the Work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on 1 side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 14 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

3.02 CONSTRUCTION JOINTS

- A. Construction joints shall be as shown on the Drawings. Otherwise, Contractor shall submit description of the joint and its location to Engineer for approval.
- B. Unless noted otherwise on the Drawings, construction joints shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point. In this case, the joints in the girders shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and the top of footings or floor slabs unless noted otherwise on Drawings. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.
- C. Unless noted otherwise on the Drawings, maximum Maximum1 distance between horizontal joints in slabs and vertical joints in walls shall be 45' 0". For exposed walls with fluid or earth on the opposite side, the spacing between vertical and horizontal joints shall be a maximum of 25'-0" unless noted otherwise on the Drawings1.

- D. All corners shall be part of a continuous placement, and should a construction joint be required, the joint shall not be located closer than five feet from a corner.
- E. All reinforcing steel and welded wire fabric shall be continued across construction joints. Keys and inclined dowels shall be provided as shown on the Drawings or as directed by the Engineer. Longitudinal keys shall be provided in all joints in walls and between walls and slabs or footings, except as specifically noted otherwise on the Drawings. Size of keys shall be as shown on the Drawings.
- F. All joints in water bearing structures shall have a waterstop. All joints below grade in walls or slabs which enclose an accessible area shall have a waterstop.

3.03 SPLICES IN PVC WATERSTOPS

- A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and of its tubular center axis be maintained.
- B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- C. All joints in waterstop involving more than 2 ends to be joined together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be factory fabricated with not less than 24-inch long strips of material beyond the joint. Upon being inspected and accepted, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24 inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.

3.04 JOINT CONSTRUCTION

- A. Setting PVC Waterstops: In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support the waterstops during the progress of the Work and to insure the proper imbedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.
- B. In placing PVC waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise shown, all waterstops shall be held in place with light wire ties on 12 inch centers which shall be passed through the edge of the waterstop and tied to the curtain of reinforcing steel. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane,

concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.

- C. Joint Location: Construction joints, and other types of joints, shall be provided where shown on the Drawings. When not shown on the Drawings, maximum distance between horizontal joints in slabs and vertical joints in walls shall be 45-feet, and maximum distance between vertical and horizontal joints for earth or water retaining walls shall be 25-feet, unless noted otherwise. The location of all joints, of any type, shall be submitted for review by the Engineer.
- D. Joint Preparation: Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise shown on the Drawings, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with the requirements of Section 03300 entitled "Cast in Place Concrete."
- E. Adequate means shall be provided for anchoring the waterstop in concrete. Waterstops shall be positioned so that they are equally embedded in the concrete on each side of the joint.
- F. Sealant application shall be in accordance with the manufacturer's printed instructions. The surfaces of the groove for the sealant shall not be coated. Concrete next to waterstops shall be placed in accordance with the requirements of Section entitled, "Cast in Place Concrete."
- G. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. All sealant shall cure at least 7 days before the structure is filled with water.
- H. All sealant shall be installed by a competent waterproofing specialty contractor who has a successful record of performance in similar installations. Before work is commenced, the crew doing the Work shall be instructed as to the proper method of application by a representative of the sealant manufacturer.
- I. Thorough, uniform mixing of 2 part, catalyst cured materials is essential; special care shall be taken to properly mix the sealer before its application. Before any sealer is placed, the Contractor shall arrange to have the crew doing the Work carefully instructed as to the proper method of mixing and application by a representative of the sealant manufacturer.
- J. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the Work hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re sealed with the specified joint sealant. All costs of such removal, joint treatment, re sealing, and appurtenant work shall be at the expense of the Contractor.

3.05 INSTALLATION OF EXPANSION JOINT MATERIAL AND SEALANTS

- A. Type I, II, or III shall be used in all expansion joints in structures and concrete pavements unless specifically shown otherwise on the Drawings. Type IV shall be used in sidewalk and curbing and other locations specifically shown on the Drawings.

- B. All expansion joints exposed in the finish work, exterior and interior, shall be sealed with the specified joint sealant. Expansion joint material and sealants shall be installed in accordance with manufacturer's recommended procedures and as shown on the Drawings.
- C. Expansion joint material that will be exposed after removal of forms shall be cut and trimmed to ensure a neat appearance and shall completely fill the joint except for the space required for the sealant. The material shall be held securely in place and no concrete shall be allowed to enter the joint or the space for the sealant and destroy the proper functions of the joint.
- D. A bond breaker shall be used between expansion joint material and sealant. The joint shall be thoroughly clean and free from dirt and debris before the primer and the sealant are applied. Where the finished joint will be visible, masking of the adjoining surfaces shall be carried out to avoid their discoloration. The sealant shall be neatly tooled into place and its finished surfaces shall present a clean and even appearance.
- E. Type 1 joint sealant shall be used in all expansion and contraction joints in concrete, except where Type 7 or Type 8 is required as stated below, and wherever else specified or shown on the Drawings. It shall be furnished in pour grade or gun grade depending on installation requirements. Primers shall be used as required by the manufacturer. The sealant shall be furnished in colors as directed by the Engineer.
- F. Type 8 joint sealant shall be used in all concrete pavements and floors subject to heavy traffic and wherever else specified or shown on the Drawings.
- G. Type 7 joint sealant shall be used for all joints in chlorine contact tanks and wherever specified or shown on the Drawings.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials for concrete in accordance with the provisions of this Section and shall form, mix, place, cure, repair, finish, and do all other work as required to produce finished concrete, all in accordance with the requirements of the Contract Documents.
- B. The requirements in this section shall apply to the following types of concrete:
 - 1. Class A1 Concrete: Normal weight concrete used at all non-water-bearing structures, unless otherwise noted.
 - 2. Class A2 Concrete: Normal weight concrete used at all water-bearing structures and containment structures, unless otherwise noted.
 - 3. Class A3 Concrete: Normal weight concrete used at all walls of water bearing structures. Class A3 concrete is similar to Class A2 except Class A3 shall contain a mandatory addition of high range water reducer to aid in placement of concrete.
 - 4. Class B Concrete: Normal weight concrete with pea-rock aggregate. Class B concrete shall be used only at locations indicated on the Drawings or specifically requested by the contractor and approved by the Engineer.
 - 5. Class C Concrete: Normal weight concrete used in electrical/instrumentation ductbanks, pipe encasements and sidewalks.
 - 6. Flowable Fill: Lean concrete proportioned without the use of coarse aggregate primarily for use as pipe backfill. Flowable fill shall be utilized only at locations indicated on the Drawings or approved by the Engineer.
 - 7. Tremie Concrete: Concrete indicated to be placed underwater.
 - 8. Grout is specified in Section 03315 entitled "Grout".

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 01400 - Quality Control
- C. Section 03100 - Concrete Formwork
- D. Section 03200 - Concrete Reinforcement
- E. Section 03400 - Precast Concrete, General
- F. Section 03315 - Grout

G. Section 05500 - Metal Fabrications

H. Section 07190 - Vapor Barrier

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code (FBC) and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.

B. Codes and Standards

C. The Building Code, as referenced herein, shall be the Florida Building Code.

D. Federal Specifications

1. UU B 790A (Int.Amd. 1) Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).

E. Commercial Standards

1. ACI 214 Recommended Practice for Evaluation of Strength Test Results of Concrete.
2. ACI 301 Specifications for Structural Concrete for Buildings.
3. ACI 305 Hot Weather Concreting.
4. ACI 306 Cold Weather Concreting.
5. ACI 309 Recommended Practice for Consolidation of Concrete
6. ACI 315 Details and Detailing of Concrete Reinforcement.
7. ACI 318 Building Code Requirements for Reinforced Concrete.
8. ACI 347 Recommended Practice for Concrete Formwork.
9. ACI 350 Environmental Engineering Concrete Structures.
10. ASTM C 31 Methods of Making and Curing Concrete Test Specimens in the Field.
11. ASTM C 33 Specification for Concrete Aggregates.
12. ASTM C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C 88 Test Method for Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.
14. ASTM C 94 Specification for Ready-Mixed Concrete.
15. ASTM C 114 Method for Chemical Analysis of Hydraulic Cement.

16. ASTM C 136 Method for Sieve Analysis of Fine and Coarse Aggregate.
17. ASTM C 143 Test Method for Slump of Portland Cement Concrete.
18. ASTM C 150 Specification for Portland Cement.
19. ASTM C 156 Test Method for Water Retention by concrete Curing Materials.
20. ASTM C 157 Test Method for length Change of Hardened Cement Mortar and Concrete.
21. ASTM C 192 Method of Making and Curing concrete Test Specimens in the Laboratory.
22. ASTM C 227 Standard Test Method for Potential Alkali Reactivity of Cement Aggregate Combinations (Mortar-Bar Method).
23. ASTM C 260 Specification for Air-Entraining Admixtures for Concrete.
24. ASTM C 289 Standard Test Method for Potential Reactivity of Aggregates (Chemical Method).
25. ASTM C 494 Specification for Chemical Admixtures For Concrete.
26. ASTM C 586 Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method).
27. ASTM C 618 Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.
28. ASTM D 1751 Specification for preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
29. ASTM D 6103 Standard Test Method for Flow Consistency of Controlled Low Strength Material
30. ASTM E11 Specification for Wire-Cloth Sieves for Testing Purposes.
31. ASTM E 119 Method for Fire Tests of Building Construction and Materials.

1.04 SUBMITTALS

- A. The design mixes to be used shall be prepared by qualified persons and submitted for review. The design of the mix is the responsibility of the Contractor subject to the limitations of the specifications. Review processing of this submission will be required only as evidence the mix has been designed by qualified persons and that the minimum requirements of the specifications have been met. Such review will in no way alter the responsibility of the Contractor to furnish concrete meeting the requirements of the specifications. If in the progress of the work the sources of materials change in characteristics or the Contractor requests a new source in writing, the Contractor shall, at his expense submit new test data and information for the establishment of a new design mix. Submit mix designs for all classes of concrete proposed for use under this Contract. Mix design submittals shall include the following:

1. Sources of all materials and certifications of compliance with specifications for all sources of each material.
 2. Certified current (less than one year old) chemical analysis of Portland Cement or Blended Cement to be used.
 3. Certified current (less than one year old) chemical analysis of fly ash to be used.
 4. Aggregate test results showing compliance with required standards, i.e. sieve analysis, aggregate soundness tests, etc.
 5. Manufacturer's data on all admixtures stating compliance with required standards and are compatible with one another. Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the Engineer.
 6. Field experience records and/or trial mix data for the proposed concrete mixes.
- B. Where ready-mix concrete is used, the Contractor shall provide delivery tickets at the time of delivery of each load of concrete. In addition to the information required by ASTM C94, each ticket shall show the mix number, cement content, water/cementitious ratio, and amount of water allowed to be added to truck without exceeding required water/cementitious ratio.
- C. A schedule of all concrete placement with volume of concrete planned to be placed each day.
- D. A layout of all structures with all planned construction joint locations.

1.05 QUALITY ASSURANCE

- A. Plant equipment and facilities shall meet all requirements of the Check List for Certification of Ready Mixed Concrete Production facilities of the National Ready Mixed Concrete Association and ASTM C 94.
- B. Tests for compressive strength and slump of concrete will be performed as specified herein. Test for determining slump will be in accordance with the requirements of ASTM C 143.
- C. The cost of initial trial mixes and initial laboratory tests to design the mixes including compression tests, sieve analysis, and tests on trial mixes shall be included in the Contract Price.
- D. The cost of all tests during construction will be borne by the City. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the Specifications. All test results shall be sent directly to the Engineer. All testing invoices shall be sent directly to the City. The Contractor shall be responsible for coordination of all tests with the testing laboratory.
- E. Concrete for testing shall be supplied by the Contractor at no cost to the City City1, and the Contractor shall provide assistance to the Engineer in obtaining samples. The Contractor shall dispose of and clean up all excess material.
- F. Construction Tolerances

- G. The Contractor shall set and maintain concrete forms and perform finishing operations so as to ensure that the completed work is within the tolerances specified herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the specified permissible variation from lines, grades, or dimensions shown. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 347 and Section 03100 entitled "Concrete Formwork".

1.06 QUALITY CONTROL

A. Compressive Strength

1. Compression test specimens shall be taken during construction from the first placement of each class of concrete specified herein and at intervals thereafter as selected by the Engineer to insure continued compliance with these Specifications. At least one set of test specimens shall be made for each placement in excess of five cubic yards, or for each fifty (50) cubic yards of concrete placed, or for each 5000 square feet of surface area for slabs or walls, whichever is greater.
2. Samples of freshly mixed concrete shall be obtained in accordance with ASTM C 172, and compression test specimens for concrete shall be made in accordance with ASTM C 31. Specimens shall consist of at least five 6-inch diameter by 12-inch high cylinders, or eight 4-inch diameter by 8-inch high cylinders. Each cylinder shall be identified by a tag attached to the side of the cylinder.
3. The Contractor shall provide approved curing boxes for storage of cylinders on site. The insulated curing box shall be of sufficient size and strength to contain all the specimens made in any four consecutive working days and to protect the specimens from falling over, being jarred or otherwise disturbed during the period of initial curing. The box shall be erected, furnished and maintained by the Contractor. Such box shall be equipped to provide the moisture and to regulate the temperature necessary to maintain the proper curing conditions required by ASTM C31. Such box shall be located in an area free from vibration such as pile driving and traffic of all kinds. No concrete requiring inspection shall be delivered to the site until such storage curing box has been provided. Specimens shall remain undisturbed in the curing box until ready for delivery to the testing laboratory but not less than sixteen hours
4. Compression test shall be performed in accordance with ASTM C 39. For 6x12 cylinders, two test cylinders will be tested at 7 days and 2 at 28 days. For 4x8 cylinders, three test cylinders will be tested at 7 days and three at 28 days. The remaining cylinders will be held to verify test results, if needed.

B. Consistency

1. Consistency of the concrete will be checked by the Engineer by standard slump cone tests. The Contractor shall make any necessary adjustments in the mix as the Engineer may direct and shall upon written order suspend all placing operations in the event the consistency does not meet the intent of the specifications. No payment shall be made for delays, material or labor costs due to such eventualities.

2. Slump tests shall be made in accordance with ASTM C 143. Slump tests shall be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

C. Air Content

1. Samples of freshly mixed concrete will be tested for entrained air content by the Engineer in accordance with ASTM C 231.
2. Air content tests will be performed as deemed necessary by the Engineer and each time compressive strength samples are taken.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be according to the requirements of ACI 215 and ACI 318, Chapter 5 "Concrete Quality Mixing and Placing", and as specified herein.
2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for all subsequent batches of the type of concrete affected.
3. All concrete which fails to meet the ACI requirements and these specifications, is subject to removal and replacement at the cost of the Contractor. Additional testing may also be required to verify compressive strength of concrete. Additional testing shall involve extraction and testing of concrete cores in accordance with ASTM C 42. Engineer shall determine locations where concrete cores shall be taken. Nondestructive test methods shall not be used to verify strength of in-place concrete.

1.07 PRE-CONCRETE CONFERENCE

- A. At least 35 days prior to start of the Concrete construction schedule, the Contractor shall conduct a meeting to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete construction. The Contractor shall send a pre-concrete conference agenda to all attendees 20 days prior to the scheduled date of the conference.
- B. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
 1. Contractor's superintendent
 2. For the concrete design mix – Laboratory retained for trial batching and tests
 3. For field quality control – Concrete subcontractor, Concrete producer, Admixture Manufacturer(s), Concrete pumping Contractor
- C. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by him to all parties concerned within five days of the meeting. One copy of the minutes shall also be transmitted to the Engineer.

- D. The minutes shall include a statement by the admixture manufacturer(s) indicating that the proposed mix design and placing techniques can produce the concrete quality required by these Specifications.
- E. The Engineer will be present at the conference. The Contractor shall notify the Engineer at least 20 days prior to the scheduled date of the conference.

PART 2 - MATERIALS

2.01 CONCRETE MATERIALS

- A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. All cement shall be used in the sequence of receipt of shipments.
- B. All materials furnished and stored for the work shall comply with the requirements of ACI 301, as applicable.
- C. Materials for concrete shall conform to the following requirements:
 - 1. Cement shall be standard brand Portland cement conforming to ASTM C150 or ASTM C595, Type I/II or IL. Portland cement shall contain no more than 0.60 percent alkalis. The term "alkalis" referred to herein is defined as the sum of the percentage of sodium oxide and 0.658 times the percentage of potassium oxide ($\text{Na}_2\text{O} + 0.658 \text{K}_2\text{O}$). These oxides shall be determined in accordance with ASTM C 114. A single brand of cement shall be used throughout the Work, and prior to its use, the brand shall be acceptable to the Engineer. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports for each shipment of cement to be used shall be submitted to the Engineer if requested regarding compliance with these Specifications.
 - 2. Fly ash shall meet the requirements of ASTM C 618 for Class F, except the loss on ignition shall not exceed 4%. The fly ash constituent shall be maximum 15% of the total weight of the combined Portland cement and fly ash. For concrete to be used in environmental concrete structures, i.e. process structures or fluid containing structures, inclusion of fly ash in concrete mix is mandatory.
 - 3. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies.
 - 4. Aggregates shall be obtained from pits acceptable to the Engineer, shall be non reactive, and shall conform to the FBC and ASTM C 33. Maximum size of coarse aggregate shall be as specified in Article 2.04, Paragraph B of this Section. Lightweight sand for fine aggregate will not be permitted.
 - a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock or a combination thereof. The coarse aggregates shall be

prepared and handled in two or more size groups for combined aggregates with a maximum size not greater than 1 inch. When the aggregates are proportioned for each batch of concrete the two size groups shall be combined.

- b. Fine aggregates shall be manufactured sand that is hard and durable.
- c. Combined aggregates shall be well graded from coarse to fine sizes, and shall be uniformly graded between screen sizes to produce a concrete that has optimum workability and consolidation characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
- d. When tested in accordance with "Potential Reactivity of Aggregates (Chemical Method)" (ASTM C 289), the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
- e. When tested in accordance with "Organic Impurities in Sands for Concrete" (ASTM C 40), the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
- f. When tested in accordance with "Resistance to Abrasion of Small size Coarse Aggregate by Use of the Los Angeles Machine" (ASTM C 131), the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions, or 10.5 percent after 100 revolutions.
- g. When tested in accordance with "Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate" (ASTM C 88), the loss resulting after five cycles shall not exceed 10 percent for fine or coarse aggregate when using sodium sulfate.

2.02 ADMIXTURES

- A. Air-entraining agent meeting the requirements of ASTM C 260, shall be used. Sufficient air-entraining agent shall be used to provide a total air content of 3 to 5 percent. Air-entraining agent shall be Sika AER by Sika Corp., MB-VR by Master Builders, Darex AEA by Grace, AEA-92S by Euclid Chemical Company, or equal.
- B. Admixtures shall be required at the Engineer's discretion or, if not required, may be added at the Contractor's option to control the set, effect water reduction, and increase workability. In either case, the addition of an admixture shall be at the Contractor's expense. The use of an admixture shall be subject to acceptance by the Engineer. Concrete containing an admixture shall be first placed at a location determined by the Engineer. If the use of an admixture is producing an inferior end result, the Contractor shall discontinue use of the admixture. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, be non toxic after 30 days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.
 - 1. Water reducing admixture shall conform to ASTM C 494, Type A and shall contain no more than 0.05% chloride ions. Acceptable products are "Eucon Series" by the Euclid Chemical Company, "Pozzoloth Series" by BASF, and "Plastocrete Series" by Sika Corporation.

2. High range water reducer shall be sulfonated polymer conforming to ASTM C 494, Type F or G. The use of high range water reducer is mandatory for Class A2 A3 1 concrete. The high range water reducer shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system. Concrete shall be mixed at mixing speed for a minimum of 100 mixer revolutions after the addition of the high range water reducer. Acceptable products are "Eucon 37" or Plastol 5000 by the Euclid Chemical Company, "Rheobuild 1000 or Glenium Series" by BASF, and "Daracem 100 or Advaflow Series" by W.R. Grace.
3. A non-chloride, non-corrosive accelerating admixture shall be used when air temperature at time of placement is expected to be consistently below 40 degrees Fahrenheit as specifically approved by the Engineer. The admixture shall conform to ASTM C 494, Type C or E, and shall not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures. Acceptable products are "Accelguard 80/90 or NCA" by the Euclid Chemical Company and "Daraset" by W.R. Grace.
4. A water reducing retarding admixture shall be used when air temperature at time of placement is expected to be consistently above 90 degrees Fahrenheit as specifically approved by the Engineer. The admixture shall conform to ASTM, Type D and shall not contain more than 0.05% chloride ions. Acceptable products are "Eucon NR or Eucon Retarder 100" by the Euclid Chemical Company, "Pozzolith Retarder" by BASF, and "Plastiment" by Sika Corporation.
5. The Contractor shall submit certification from each admixture manufacturer that all admixtures utilized in the design mix are compatible with one another and properly proportioned.
6. Prohibited Admixtures: Calcium chloride, thiocyanate or admixtures containing more than 0.05 percent chloride ions are not permitted.
7. Certification: Written conformance to the above mentioned requirements and the chloride ion content of the admixture will be required from the admixture manufacturer prior to Mix design review by the Engineer.

2.03 ACCESSORIES

- A. Epoxy adhesives shall be the following products for the applications specified to be used in strict accordance with manufacturer's recommendations.
 1. For bonding freshly mixed, plastic concrete to hardened concrete, Sikadur 32 Hi Mod, LPL Epoxy Adhesive, as manufactured by Sika Chemical Corporation; Concsive 1001 LPL, as manufactured by Adhesive Engineering Company; or equal.
 2. For bonding hardened concrete or masonry to steel, Colma Dur Gel, Sikadur Hi Mod Gel, or equal.

2.04 CONCRETE MIX

- A. Concrete shall be composed of cement, admixtures, aggregates and water. These materials shall be of the qualities specified. The exact proportions in which these materials are to be used for different parts of the work will be determined by the Contractor. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface. Mix designs with more than 41 percent of sand of the total weight of fine and coarse aggregate shall not be used for Class A Concrete. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the City. All changes shall be subject to review by the Engineer.
- B. The proportions of cement, aggregates, admixtures and water used in the concrete shall be based on tests of grading and moisture content of materials, slump of concrete mixture, strength of concrete and the following factors:

1. Class A1 Concrete (Normal weight concrete used at all non-water bearing structures, unless noted otherwise).

Minimum cementitious materials content, per cubic yard	611 lbs.
Minimum water-cementitious material ratio, by weight	0.28
Maximum water-cementitious materials ratio, by weight	0.45
Slump range	3 inches to 4 inches with water reducing admixture
Coarse Aggregate	#57 per ASTM C33
Compressive strength at 28 days – F'c	4,000 psi
Air Content	3% ± 1%

2. Class A2 Concrete (Normal weight concrete used at all water bearing structures and containment structures, unless noted otherwise).

Minimum cementitious materials content, per cubic yard	611 lbs.
Minimum water-cementitious material ratio, by weight	0.28
Maximum water-cementitious materials ratio, by weight	0.42
Slump range	3 inches to 4 inches with water reducing admixture

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- | | |
|---------------------------------------|------------------|
| Coarse Aggregate | #57 per ASTM C33 |
| Compressive strength at 28 days – F'c | 4,500 psi |
| Air Content | 3% ± 1% |
3. Class A3 Concrete (Normal weight concrete used at all walls of water bearing structures. Class A3 concrete is similar to Class A2 except class A3 shall contain a mandatory addition of high range water reducer).
- | | |
|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Minimum cementitious materials content, per cubic yard | 611 lbs. |
| Minimum water-cementitious material ratio, by weight | 0.28 |
| Maximum water-cementitious materials ratio, by weight | 0.42 |
| Slump range | 3 inches maximum before addition of high range water reducing admixture
8 inches maximum after addition of high range water reducing admixture |
| Compressive strength at 28 days - F'c | 4,500 psi |
| Coarse Aggregate | #57 per ASTM C33 |
| Air Content | 3% ± 1% |
4. Class B Concrete (At locations shown on the Drawings).
- | | |
|--------------------------------------------------------|-----------|
| Minimum cementitious materials content, per cubic yard | 517 lbs. |
| Minimum water-cementitious material ratio, by weight | 0.28 |
| Maximum water-cementitious materials ratio, by weight | 0.50 |
| Slump, maximum | 5 inches |
| Compressive strength at 28 days - F'c | 4,000 psi |
| Coarse Aggregate | Pearock |
| Air Content | 3% ± 1% |
5. Class C Concrete (Sidewalks, pipe encasements in the dry, thrust blocks and electrical duct banks)
- | | |
|-----------------------------------------|----------|
| Minimum cementitious materials content, | 500 lbs. |
|-----------------------------------------|----------|

per cubic yard

Maximum water-cementitious materials ratio, by weight	0.60
Slump, maximum	5 inches
Compressive strength at 28 days - F'c	3,000 psi
Coarse Aggregate	#57 per ASTM C33
Air Content	3% ± 1%

6. Flowable Fill (In lieu of pipe bedding, select backfill)

Minimum cementitious materials content, per cubic yard	100 lbs.
Maximum water-cementitious materials ratio, by weight	5.0
Flowability, minimum	8 inches
Compressive strength at 28 days - F'c	50-150 psi
Coarse aggregate	none
Fine aggregate	limestone screenings

7. Tremie Concrete (Concrete placed under water)

Minimum cement content, per cubic yard	700 lbs.
Maximum water-cementitious materials ratio, by weight	0.45
Slump, maximum	9 inches
Compressive strength lbs. per sq. inch at 28 days - F'c	4,500

C. All Class A1, A2 and A3 concrete, unless noted otherwise on the Drawings, shall be air entrained concrete. A water reducing admixture may be added to the mix at the Contractor's option.

D. The mix proportions used shall be changed subject to the limitation specified herein, whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish and the Contractor shall be entitled to no additional compensation because of such changes.

2.05 CONSISTENCY

A. The quantity of water entering into a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete which can be worked properly into place without segregation, and which can be compacted by the vibratory methods herein specified to give the desired density, impermeability and smoothness of surface. The quantity of water shall

be changed as necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143.

1.02 READY MIXED CONCRETE

- A. Ready mixed concrete shall be used meeting the requirements as to materials, batching, mixing, transporting, and placing as specified herein and in accordance with ASTM C 94.
- B. Ready mixed concrete shall be delivered to the site of the work, and discharge shall be completed within one and one half hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever is first. Upon delivery from the truck concrete temperature shall not exceed 90 degrees Fahrenheit.
- C. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. All materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolution of mixing.

PART 3 - EXECUTION

3.01 PROPORTIONING AND MIXING

- A. Proportioning of the concrete mix shall be based on the results of field experience or laboratory trial mixes in conformance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318. When trial mixes are used they shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301; provided, that the maximum slump for any concrete shall not exceed the limits specified in this Section of the Specifications.
- B. When field experience records are inadequate to confirm the quality of a proposed concrete mix in accordance with Section 5.3, "Proportioning on the Basis of Field Experience and/or Trial Mixtures" of ACI 318, or when required by the Engineer, an independent testing laboratory designated by the Contractor and acceptable to the Engineer shall test a trial batch of each of the preliminary concrete mixes submitted by the Contractor. The trial batches shall be prepared using the aggregates, cement and admixtures proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain enough samples to satisfy requirements stated below. Tests on individual materials stated in PRODUCTS should already be performed before any trial mix is done. The cost of laboratory trial batch tests for each specified concrete mix will be borne by the Contractor and the Contractor shall furnish and deliver the materials to the testing laboratory at no cost to the City.

- C. An independent testing laboratory shall observe the preparation of the trial batch, and they shall prepare a minimum of fifteen (15) standard test cylinders in accordance with ASTM C 31 in addition to conducting slump (ASTM C 143), air content (C 231) and unit weight (C 138) tests. Compressive strength test on the cylinders shall subsequently be performed by the same laboratory in accordance with ASTM C 39 as follows: Test 3 cylinders at age 7 days; test 3 cylinders at age 21 days; test 3 cylinders at age 28 days and test 3 cylinders at 56 days. The cylinders shall be carefully identified as "Trial Mix, Contract No. _____, Product _____." If the average 28-day compressive strength of the trial mix is less than that specified, or if any single cylinder falls below the required strength by more than 500 psi, the mix shall be corrected, another trial batch prepared, test cylinders taken, and new tests performed as before. Any such additional trial batch testing required shall be performed at no additional cost to the City. Adjustments to the mix shall be considered refinements to the mix design and shall not be the basis for extra compensation to the Contractor.
- D. Mixing of concrete shall conform to the requirements of Chapter 7 of ACI 301 Specifications.
- E. Retempering of concrete or mortar which has partially hardened will not be permitted.

3.02 PREPARATION

- A. Earth surfaces shall be thoroughly wetted by sprinkling, prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. A vapor barrier specified in Section 07190 entitled "Vapor Barrier" shall be placed. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. No concrete shall be placed until the reinforcement steel and formwork have been erected in a manner acceptable to the Engineer. The Contractor shall notify the Engineer not less than two working days prior to Concrete Placement, allowing one day for review and any corrective measures which are required.
- C. Joints in Concrete
 - 1. Concrete surfaces upon or against which concrete is to be placed shall be given a roughened surface for good bond and a bonding agent shall be placed. Contractor shall use an epoxy bonding agent for bonding fresh concrete to existing concrete where shown on the drawings.
 - 2. After the surfaces have been prepared all horizontal construction joints shall be covered with a layer of mortar approximately one inch thick. The mortar shall have the same proportions of cement and sand as the regular concrete mixture. The water cement ratio of the mortar in place shall not exceed that of the concrete to be placed upon it, and the consistency of the mortar shall be suitable for placing and working in the manner hereinafter specified. The mortar shall be spread uniformly and shall be worked thoroughly into all irregularities of the surface. Wire brooms shall be used where possible to scrub the mortar into the surface. Concrete shall be placed immediately upon the fresh mortar.
- D. Placing Interruptions

1. When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent work; provided that construction joints shall be made only where acceptable to the Engineer. Cold joints will be sufficient cause for rejection of the work.

E. Embedded Items

1. No concrete shall be placed until all formwork, installation of parts to be embedded, reinforcing steel, and preparation of surfaces involved in the placing have been completed and accepted by the Engineer at least four hours before placement of concrete. All surfaces of forms and embedded items that have become encrusted with dried grout from concrete previously placed shall be cleaned of all such grout before the surrounding or adjacent concrete is placed.

2. All inserts or other embedded items shall conform to the requirements herein.

- F. All reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms where shown on the Drawings or by shop drawings and shall be acceptable to the Engineer before any concrete is placed. Accuracy of placement is the responsibility of the Contractor.

- G. All anchor bolts called for on the drawings shall be cast in place in the concrete. Drilled, impact, adhesive or other types of anchors shall not be substituted for anchor bolts unless otherwise shown on the Drawings. Anchor bolts shall conform to the requirements set forth in Section 05050 entitled "Metal Fastening".

H. Casting New Concrete Against Old

1. Where concrete is to be cast against old concrete (any concrete which is greater than 60 days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by sand blasting (exposing aggregate) prior to the application of an epoxy bonding agent.

- I. No concrete shall be placed in any structure until all water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the work. No concrete shall be deposited underwater, except where shown on the Drawings to be placed by the tremie method, nor shall the Contractor allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, will be subject to the review of the Engineer.

J. Corrosion Protection

1. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

2. Openings for pipes, inserts for pipe hangers and brackets, and the setting of anchors shall, where practicable, be provided for during the placing of concrete.
3. Anchor bolts shall be accurately set, and shall be maintained in position by templates while being embedded in concrete.
4. The surfaces of all metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.03 PLACING CONCRETE

A. Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section.

B. Non Conforming Work or Materials

1. Concrete which upon or before placing is found not to conform to the requirements specified herein shall be rejected and immediately removed from the Work. Concrete which is not placed in accordance with these Specifications, or which is of inferior quality, shall be removed and replaced by and at the expense of the Contractor.

C. Unauthorized Placement

1. No concrete shall be placed except in the presence of duly authorized representative of the Engineer. The Contractor shall notify the Engineer at least 24 hours in advance of placement of any concrete.

D. Placement in Wall Forms

1. Concrete shall not be dropped through reinforcement steel or into any deep form, whether reinforcement is present or not, causing separation of the coarse aggregate from the mortar on account of repeatedly hitting rods or the sides of the form as it falls, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, some means such as the use of hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete exceed 4 feet below the ends of ducts, chutes, or buggies.
2. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6 feet in horizontal direction. Concrete in forms shall be deposited in uniform horizontal layers not deeper than 2 feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in forms shall not exceed 5 feet of vertical rise per hour.

E. Casting New Concrete Against Old

1. An epoxy adhesive bonding agent shall be applied to set surfaces of construction joints according to the manufacturer's written recommendations.

F. Conveyor Belts and Chutes

1. All ends of chutes, hopper gates, and all other points of concrete discharge throughout the Contractor's conveying, hoisting and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the Engineer. Chutes longer than 50 feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the specified consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. All conveyor belts and chutes shall be covered. Sufficient illumination shall be provided in the interior of all forms so that the concrete at the places of deposit is visible from the deck or runway.

G. Placement in Slabs

1. Concrete placed in sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the pour. As the work progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up slope direction.

H. Temperature of Concrete

1. The temperature of concrete when it is being placed shall be not more than 90 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the specified minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees Fahrenheit, the Contractor shall employ effective means, such as precooling of aggregates and mixing water using ice or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The Contractor shall be entitled to no additional compensation on account of the foregoing requirements. During summer months concrete pours shall be scheduled in the morning or early part of the day when temperatures are cooler.

I. Pumping Equipment

1. Pumping equipment and procedures if used shall conform to the recommendations contained in the report of ACI Committee 304 on Placing Concrete by Pumping Methods, ACI 304.2R. The specified slump shall be measured at the point of discharge. The loss of slump in pumping shall not exceed 1-1/2 inches.

- J. The order of placing concrete in all parts of the work shall be acceptable to the Engineer. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 7 days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 14 days.

- K. The surface of the concrete shall be level whenever a run of concrete is stopped. To insure a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and all laitance shall be removed.
- L. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted, throughout the entire depth of the layer which is being consolidated, into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete during placement. Vibrators shall be high speed power vibrators (8000 to 10,000 rpm) of an immersion type in sufficient number and with (at least one) standby units as required.
- M. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that all air and rock pockets have been eliminated. Where flat strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that all air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration, over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- N. Concrete in walls shall be internally vibrated and at the same time, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against all surfaces. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly as specified. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the results herein specified within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall be kept from contact with the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.04 CONCRETE FINISHING

- A. Concrete finishes are specified in Section 03350 entitled "Concrete Finishes".

3.05 CURING AND PROTECTION

- A. Curing is specified in Section 03370 entitled "Concrete Curing".

3.06 CONCRETE IN COLD WEATHER

- A. Cold weather concreting procedures shall be in accordance with the requirements of ACI 306.

3.07 CONCRETE IN HOT WEATHER

- A. Hot weather concreting procedures shall conform to the requirement of ACI 305.

3.08 PLACING CONCRETE UNDERWATER (TREMIE CONCRETE)

- A. Placing concrete underwater will be permitted only when shown on the Drawings. Concrete deposited under water shall be carefully placed in a compacted mass in final position by means of a tremie, a closed bottom dump bucket or other approved method. Care must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. The consistency of the concrete shall be regulated to prevent segregation of materials. The method of depositing concrete shall be regulated such that the concrete enters the mass of the previously place concrete from within, displacing water with a minimum disturbance to the surface of the concrete.
- B. Tremie shall consist of a tube having a diameter of not less than 10 inches and constructed in sections having flanged couplings fitted with gaskets. The tremie shall be supported to permit free movement of the discharge and over the entire top surface of the work and shall permit rapid lowering when necessary to choke off or retard the flow. The discharge end shall be entirely sealed at all times and the tremie tube kept full to the bottom of the hopper. When a batch is dumped into the hopper, the tremie shall be slightly raised, but not out of the concrete at the bottom, until the batch discharges to the bottom of the hopper. The flow shall then be stopped by lowering the tremie. The flow shall be continuous until the placement has been completed.

3.09 PLACING CONCRETE UNDER PRESSURE (PUMPING)

- A. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall have the capacity for the operation. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends with no change in pipe size. If two sizes of pipe must be used, the smaller diameter should be used at the pump end and the larger at the discharge end. When pumping is completed, the concrete remaining in the pipelines, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.
- B. No aluminum parts shall be in contact with the concrete during the entire placing of concrete under pressure at any time.
- C. Prior to placing concrete under pressure, the Contractor shall submit the concrete mix design together with test results from a recognized testing laboratory proving the proposed mix meets all requirements. In addition, at the Contractor's option, an actual pumping test under field conditions may be performed prior to use of the accepted mix. This test requires a duplication of anticipated site conditions from beginning to end. The batching and truck mixing shall be the same as will be used; the same pump and operator shall be present and the pipe and pipe layouts will reflect the maximum height and distance contemplated.
- D. If the pumped concrete does not produce satisfactory end results, the Contractor shall discontinue the Pumping operation and proceed with the placing of concrete using conventional methods.

- E. The pumping equipment must have two cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the Contractor may have a standby pump on the site during pumping.
- F. The minimum diameter of the hose (conduits) shall be four inches.
- G. Pumping equipment and hoses (conduits) that are not functioning properly shall be replaced.

3.10 ORDER OF PLACING CONCRETE

- A. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints shown on the Drawings and maximum lengths as indicated on Drawings. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall be have cured at least seven days before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the two adjacent wall panels have cured at least 14 days.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped.

3.11 DEFECTIVE CONCRETE

- A. As soon as forms are removed, all exposed surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until reviewed by the Engineer. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall have them repaired as specified herein. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. All repairs and replacements herein specified shall be promptly executed by the Contractor at its own expense.
- B. Defective surfaces to be repaired as specified in Article 3.11, Paragraph A of this Section, shall be cut back from trueline a minimum depth of 1/2 inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of all laitance or soft material, and not less than 1/32 inch depth of the surface film from all hard portions. The material used for repair proposed shall be approved by the Engineer.
- C. Holes left by tie rod cones shall be repaired in an acceptable manner with dry-packed cement grout or premixed patching material as accepted by the Engineer.
- D. All repairs shall be built up and shaped in such a manner that the completed work will conform to the requirements of Article 3.04 or 3.05 of this Section, as applicable, using acceptable methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of said repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.
- E. Prior to backfilling, all cracks that may have developed shall be "vee'd" and filled with sealant conforming to the requirements of Section 07920 entitled, "Sealants and

Caulking". This repair method shall be done on the faces of members in contact with fill.

3.12 CARE AND REPAIR OF CONCRETE

- A. The Contractor shall protect all concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance by the City. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed work, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete at the Contractor's expense. This stipulation includes concrete experiencing cracking due to drying or thermal shrinkage of the concrete. Structural cracks shall be repaired using an epoxy injection system approved by the Engineer. Non-structural cracks shall be repaired using a hydrophilic resin pressure injected grout system approved by the Engineer, unless other means or repair are deemed necessary and approved by the Engineer.

3.13 CONCRETE SEALER

- A. Contractor shall apply a sealer to the top surface of all finished concrete floor slabs and equipment pads which are to remain unpainted and not intended to be immersed unless stated otherwise. Sealer shall be as specified in Specification Section 03350 entitled "Concrete Finishes".

END OF SECTION

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SECTION 03315

GROUT

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials for grout in accordance with the provisions of this Section and shall form, mix place, cure, repair, finish, and do all other Work as required to produce finished grout, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03300 - Cast in Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes, and standards shall be as specified in Section 03300 entitled "Cast in Place Concrete," and as referred to herein.
- B. Additional Commercial Standards
 - 1. CRD C 621 Corps of Engineers Specification for Nonshrink Grout

1.04 SUBMITTALS

- A. The Contractor shall submit certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the work.

PART 2 - PRODUCTS

2.01 PREPACKAGED NON-SHRINK CEMENTITIOUS GROUT

- A. Nonshrink grout shall be a prepackaged, inorganic, non gas liberating, nonmetallic, cement based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of nonshrink grout specified herein shall be that recommended by the manufacturer for the particular application.
- B. Nonshrink grouts shall have a minimum 28 day compressive strength of 5000 psi (ASTM C109, restrained), shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C 827, and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.
- C. Cement based grout shall be Five Star Grout as manufactured by Five Star Products, Inc., Fairfield, Connecticut, or equal.

- D. Cementitious non-shrink grout shall be used at locations where there are no dynamic loads, the grout will not come in contact with wastewater or wastewater gases, and where non-shrink grout is identified on the Drawings. Applications include, but are not limited to, structural steel column base plates, gate frames and guides, and precast concrete to cast-in-place concrete joints.

2.02 PREPACKAGED NON-SHRINK EPOXY GROUT

- A. Epoxy-based non-shrink grout shall be a three component, 100 percent solids, solvent-free system designed for machinery grouting. Applications include, but are not limited to, anchoring, pump and motor bases, and any other equipment imparting dynamic loads to the support system.
- B. When non-shrink grout is identified on the Drawings in submerged (water or wastewater) or under wastewater gas environment, epoxy-based non-shrink grouts shall be used.
- C. The epoxy grout shall be delivered to site as prepackaged, three-component systems composing of the resin, hardener, and specially blended aggregates. The components shall be stored as recommended by the manufacturer until use.
- D. Non-shrink epoxy grout shall be Five Star DP Epoxy Grout by Five Star Products, Inc., Fairfield, Connecticut, or equal.

2.03 CEMENT GROUT

- A. Cement grout shall be composed of Portland cement and sand in the proportion specified in the Contract Documents and the minimum amount of water necessary to obtain the desired consistency. If no proportion is indicated, cement grout shall consist of one part Portland cement to three parts sand. Water amount shall be as required to achieve desired consistency without compromising strength requirements. White Portland cement shall be mixed with Portland cement as required to match color of adjacent concrete.
- B. The minimum compressive strength at 28 days shall be 4000 psi.
- C. For beds thicker than 1-1/2 inch and/or where free passage of grout will not be obstructed by coarse aggregate, 1-1/2 parts of coarse aggregate having a top size of 3/8 inch should be added. This stipulation does not apply for grout being swept in by a mechanism. These applications shall use a plain cement grout without coarse aggregate regardless of bed thickness.
- D. Sand shall conform to the requirements of ASTM C144.

2.04 DOWEL/ANCHOR BOLT ADHESIVE SYSTEM

- A. When rebar or anchor bolts are specified to be drilled in and grouted on the Drawings, an adhesive system specified in Section 03200 entitled "Concrete Reinforcement" shall be used for dowels and an adhesive system specified in Section 05050 entitled "Metal Fastening" shall be used for anchor bolts.

2.05 CURING MATERIALS

- A. Curing materials shall be as recommended by the manufacturer.

2.06 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of the above described consistency; the type of grout to be used shall be as specified herein for the particular application.

2.07 MEASUREMENT OF INGREDIENTS

- A. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 - EXECUTION

3.01 GENERAL

- A. All curing, and protection of cement grout shall be as specified in Section 03370 entitled "Concrete Curing" (Methods 1 and 2); or as recommended by manufacturer. The finish of the grout surface shall match that of the adjacent concrete.
- B. All mixing, surface preparation, handling, placing, consolidation, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

3.02 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

END OF SECTION

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SECTION 03350

CONCRETE FINISHES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials, labor, and equipment required to provide finishes of all concrete surfaces specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Formwork
- B. Section 03300 - Cast-in-Place Concrete
- C. Section 03400 - Precast Concrete, General
- D. Section 03315 - Grout

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. ACI 301 -Specifications for Structural Concrete for Buildings
 - 2. ACI 318 - Building Code Requirements for Reinforced Concrete

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 entitled "Submittals".
 - 1. Manufacturer's literature on all products specified herein.

PART 2 - PRODUCTS

2.01 CONCRETE FLOOR SEALER

- A. Floor sealer shall be Diamond Clear VOX or Super Diamond VOX by the Euclid Chemical Company, MasterKure CC 300 SB by BASF Master Builder Solutions.

2.02 CONCRETE LIQUID DENSIFIER AND SEALANT

- A. Concrete liquid densifier and sealant shall be a high performance, deeply penetrating concrete densifier and sealant. Product shall be odorless, colorless, VOC-compliant, non-yellowing silicate based solution designed to harden, dustproof and protect concrete floors subjected to heavy vehicular traffic and to resist black rubber tire marks on concrete surfaces. The product must contain a minimum solids content of 20% of

which 50% is silicate. Acceptable products are Diamond Hard by the Euclid Chemical Company, Seal Hard by L&M Construction Chemicals and MasterKure HD 210 by BASF Master Builder Solutions.

2.03 NON-METALLIC FLOOR HARDENER

- A. The specified non-metallic mineral aggregate hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specifically processed graded mineral aggregate, selected Portland cement, and necessary plasticizing agents. Acceptable products shall be "Surflex" by the Euclid Chemical Company, "Harcol" by Sonneborn, "Maximent" by BASF, and "Mastercon" by BASF.

2.04 NON-OXIDIZING HEAVY DUTY METALLIC FLOOR HARDENER

- A. Non-oxidizing heavy duty metallic floor hardener shall be formulated, processed, and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a mixture of specifically processed non-rusting aggregate, selected Portland cement, and necessary plasticizing agents. Product shall be "Diamond-Plate" by the Euclid Chemical Company, or Masterplate by BASF Construction Chemicals.

2.05 NON-SLIP FLOORING ADDITIVE

- A. Non-slip flooring additives for slip resistant floors shall be non-metallic. Non-slip flooring additives shall be Frictex NS by BASF Construction Chemicals, A-H Alox by Anti-Hydro, or Euco Grip by the Euclid Chemical Company.

PART 3 - EXECUTION

3.01 FINISHES ON FORMED CONCRETE SURFACES

- A. After removal of forms, the finishes described below shall be applied in accordance with Article 3.05 of this Section entitled "Concrete Finish Schedule". Unless the finish schedule specifies otherwise, all surfaces shall receive at least a Type I finish. The Engineer shall be the sole judge of acceptability of all concrete finish work.
 - 1. Type I - Rough: All fins, burrs, offsets, marks and all other projections left by the forms shall be removed. Projections, depressions, etc. below finished grade required to be removed will only be those greater than 1/4-inch. All holes left by removal of ends of ties, and all other holes, depressions, bugholes, air/blow holes or voids shall be filled solid with cement grout after first being thoroughly wetted and then struck off flush. The only holes below grade to be filled will be tie holes and any other holes larger than 1/4-inch in any dimension. Honeycombs shall be chipped back to solid concrete and repaired as directed by the Engineer. All holes shall be filled with tools, such as sponge floats and trowels, that will permit packing the hole solidly with cement grout. Cement grout shall consist of one part cement to three parts sand, epoxy bonding agent (for tie holes only) and the amount of mixing water shall be as little as consistent with the requirements of handling and placing. Color of cement grout shall match the adjacent wall surface.

2. Type II - Grout Cleaned: Where this finish is required, it shall be applied after completion of Type I finish. After the concrete has been predampened, a slurry consisting of one part cement (including an appropriate quantity of white cement in order to produce a color matching the surrounding concrete) and 1-1/2 parts sand passing the No. 16 sieve, by damp loose volume, shall be spread over the surface with clean burlap pads or sponge rubber floats. Mix proportions shall be submitted to the Engineer after a sample of the work is established and accepted. Any surplus shall be removed by scraping and then rubbing with clean burlap. The finish shall be kept damp for at least 36 hours after application.
3. Type III - Smooth Rubbed: Where this finish is required, it shall be applied after the completion of the Type II finish. No rubbing shall be done before the concrete is thoroughly hardened and the mortar used for patching is firmly set. A smooth, uniform surface shall be obtained by wetting the surface and rubbing it with a carborundum stone to eliminate irregularities. Unless the nature of the irregularities require it, the general surface of the concrete shall not be cut into. Corners and edges shall be slightly rounded by the use of the carborundum stone. Brush finishing or painting with grout or neat cement will not be permitted. A 100 square foot example shall be established at the beginning of the project to establish acceptability.

3.02 SLAB AND FLOOR FINISHES

- A. The finishes described below shall be applied to floors, slabs, flow channels and top of walls in accordance with Article 3.05 of this Section entitled "Concrete Finish Schedule". The Engineer shall be the sole judge of acceptability of all such finish work.
 1. Type "A" - Screeded: This finish shall be obtained by placing screeds at frequent intervals and striking off to the surface elevation required. When a Type "F" finish is subsequently to be applied, the surface of the screeded concrete shall be roughened with a concrete rake to 1/2-inch minimum deep grooves prior to final set.
 2. Type "B" - Wood Floated: This finish shall be obtained after completion of a Type "A" finish by working a previously screeded surface with a wood float until the desired texture is reached. Floating shall begin when the water sheen has disappeared and when the concrete has sufficiently hardened so that a person's foot leaves only a slight imprint. If wet spots occur, water shall be removed with a squeegee. Care shall be taken to prevent the formation of laitance and excess water on the finished surface. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finished surface shall be true, even, and free from blemishes and other irregularities.
 3. Type "C" - Cork Floated: This finish shall be similar to Type "B" but slightly smoother than that obtained with a wood float. It shall be obtained by power or band floating with cork floats.
 4. Type "D" - Steel Troweled: This finish shall be obtained after completion of a Type "B" finish. When the concrete has hardened sufficiently to prevent excess fine material from working to the surface, the surface shall be compacted and smoothed with not less than two thorough and complete steel troweling operations. In areas which are to receive a floor covering such as tile, resilient flooring, or carpeting, the

applicable Specification Sections and Contract Drawings shall be reviewed for the required finishes and degree of flatness. In areas that are intermittently wet such as pump rooms, only one troweling operation is required to provide some trowel marks for slip resistance. All edges shall be edged with an 1/8-inch tool as directed by the Engineer. The finish shall be brought to a smooth, dense surface, free from defects and blemishes.

5. Type "E" - Broom or Belt: This finish shall provide the surface with a transverse scored texture by drawing a broom or burlap belt across the surface immediately after completion of a Type "B" finish. All edges shall be edged with an 1/8-inch tool as directed by the Engineer.
6. Type "F" - Swept in Grout Topping: This finish shall be applied after a completion of a Type "A" finish. The concrete surface shall be properly cleaned, washed, and coated with a mixture of water and Portland Cement. Cement grout in accordance with Section 03315 shall then be plowed and swept into neat conformance with the blades or arms of the apparatus by turning or rotating the previously positioned mechanical equipment. Special attention shall be paid to true grades, shapes and tolerances as specified by the manufacturer of the equipment. Before beginning this finish, the Contractor shall notify the Engineer and the equipment manufacturer of the details of the operation and obtain approval and recommendations of the equipment manufacturer.
7. Type "G" - Hardened Finish: This finish shall be applied after completion of a Type "B" or Type "C" finish and prior to application of a Type "D" finish. Hardeners shall be applied in strict accordance with the manufacturer's requirements. Hardeners shall be applied using a mechanical spreader. The hardener shall be applied in two shakes with the first shake comprising of 2/3 of the total amount. Type "D" finish shall be applied following completion of application of hardener.
 - a. Non-metallic floor hardener shall be applied where specifically required on the Contract Drawings at the rate of 1.0 pounds/ft².
 - b. Non-oxidizing heavy duty metallic floor hardener shall be applied at the loading docks and where specifically required on the Contract Drawings or specified herein at the rate of 1.5 pounds/ft².
8. Type "H" - Non-Slip Finish: This finish shall be provided by applying a non-slip flooring additive concurrently with the application of a Type "D" finish and/or installation of floor sealants. Application procedure shall be in accordance with manufacturer's instructions. Finish shall be applied where specifically required on the Contract Drawings or specified herein.
9. Type "J" - Raked Finish: This finish shall be provided by raking the surface as soon as the condition of the concrete permits by making depressions of +/-1/4 inch.

3.03 CONCRETE SEALERS

- A. Concrete sealers shall be applied where specifically required on the Contract Drawings or specified herein.

- B. Sealers shall be applied after installation of all equipment, piping, etc. and after completion of any other related construction activities. Application of sealers shall be in strict accordance with manufacturer's requirements.
- C. Sealers shall be applied to all floor slabs not painted and not intended to be immersed.
- D. Floor slabs subjected to vehicular traffic shall be sealed with the concrete liquid densifier and sealer.
- E. All other floor slabs to receive sealer shall be sealed with concrete floor sealer.

3.04 FINISHES ON EQUIPMENT PADS

- A. Formed surfaces of equipment pads shall receive a Type III finish.
- B. Top surfaces of equipment pads, except those surfaces subsequently required to receive non-shrink grout and support equipment bases, shall receive a Type "D" finish, unless otherwise noted. Surfaces which will later receive grout shall, before the concrete takes its final set, be made rough by removing the sand and cement that accumulates on the top to the extent that the aggregate will be exposed with irregular indentations in the surface up to 1/2 inch deep.

3.05 CONCRETE FINISH SCHEDULE

Item	Type of Finish
Concrete surfaces indicated to receive textured coating	I
Inner face of walls of tanks, flow channels, wet wells, perimeter walls, and miscellaneous concrete structures:	
From 3 feet below water surface to bottom of wall	I*
From top of wall to 3 feet below water surface	II*
Exterior concrete walls below grade	I
Exterior exposed concrete walls, ceilings, beams, manholes, hand holes, miscellaneous structures and columns (including top of wall) to one foot below grade. All other exposed concrete surfaces not specified elsewhere	II
All interior exposed concrete vertical surfaces in buildings	III
Interior exposed ceiling, including beams	III
Floors of process equipment tanks or basins, and slabs to receive roofing material or waterproof membranes	B
All interior finish floors of buildings and structures and walking surfaces which will be continuously or intermittently wet	D
All interior finish floors of buildings and structures which are not continuously or intermittently wet	D
Floors to receive tile, resilient flooring, or carpeting	D

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Item	Type of Finish
Concrete in flow channels	D
Exterior concrete sidewalks, steps, ramps, decks, slabs on grade and landings exposed to weather	E
Floors of process equipment tanks indicated on Drawings to receive grout topping	F
Garage and storage area floors	G
Precast concrete form panels, hollow core planks, double tees	J

** Finish shall be acceptable to the coating applicator and manufacturer. See Section 09900 entitled "Painting"*

END OF SECTION

SECTION 03370
CONCRETE CURING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall protect all freshly deposited concrete from premature drying and excessively hot or cold temperatures, and maintain with minimal moisture loss at a relatively constant temperature for the period of time necessary for the hydration of the cement and proper hardening of the concrete in accordance with requirements specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03100 - Concrete Framework
- B. Section 03300 - Cast-in-Place Concrete
- C. Section 03315 - Grout
- D. Section 03350 - Concrete Finishes

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the Section entitled "Submittals", the contractor shall submit the following:
 - 1. Proposed procedures for protection of concrete under wet weather placement conditions.
 - 2. Proposed normal procedures for protection and curing of concrete.
 - 3. Proposed special procedures for protection and curing of concrete under hot and cold weather conditions.
 - 4. Proposed method of measuring concrete surface temperature changes.
 - 5. Manufacturer's literature and material certification for proposed curing compounds.

1.04 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these specifications all work hereunder shall conform to the applicable requirements of the referenced portions of the following documents, to the extent that the requirements therein are not in conflict with the provisions of this Section.
 - 1. ACI 301 Specifications for Structural Concrete for buildings
 - 2. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete
 - 3. ACI 305 Hot Weather Concreting

4. ACI 306 Cold Weather Concreting
5. ACI 308 Standard Practice for Curing Concrete
6. ASTM C171 Specifications for Sheet Materials for Curing Concrete
7. ASTM C309 Specification for Liquid Membrane - Forming Compounds for Curing Concrete
8. ASTM C1315 Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete

1.05 QUALITY ASSURANCE

- A. Curing compound shall not be used on any surface where concrete, coatings, or other material will be bonded unless the manufacturer certifies that the curing compound will not prevent bond or indicates measures to be taken to completely remove the curing compound from areas to receive bonded applications, and specifically approved by the Engineer.
- B. Care shall be taken to ensure that curing compounds are compatible with all finish concrete castings.
- C. Curing compounds shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.

PART 2 - PRODUCTS

2.01 LIQUID MEMBRANE-FORMING CURING COMPOUND

- A. Clear curing and sealing compound shall be a clear styrene acrylate type complying with ASTM C 1315, Type 1, Class A with a minimum solids content of 30%. Moisture loss shall not be greater than 0.40 kg/m² when applied at 300 sq.ft./gal. Manufacturer's certification is required. Acceptable products are Super Diamond Clear VOX by the Euclid Chemical Company, MasteKure CC 300 SB by BASF Master Builder Solutions, and Cure & Seal 30 Plus by Symons Corporation.
- B. Where specifically approved by Engineer, on slabs to receive subsequent applied finishes, compound shall conform to ASTM C 309. Acceptable products are "Kurez DR VOX" or "Kurez W VOX" by the Euclid Chemical Company. Install in strict accordance with manufacturer's requirements.

2.02 EVAPORATION REDUCER

- A. Evaporation reducer shall be BASF, "MasterKure ER 50", or Euclid Chemical "Euco-Bar".

2.03 BURLAP MATS

- A. Burlap mats shall conform to AASHTO M-182.

PART 3 - EXECUTION

3.01 PROTECTION AND CURING

- A. All freshly placed concrete work shall be protected from the elements, flowing water and from defacement of any nature during construction operations.
- B. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for maintaining the concrete in a moist condition for at least a 7-day period thereafter except for high early strength concrete, for which the period shall be at least the first three days after placement. Horizontal surfaces shall be kept covered, and intermittent, localized drying will not be permitted.
- C. Walls that will be exposed on one side with either fluid or earth backfill on the opposite side shall be continuously wet cured for a minimum of five days. Use of a curing compound will not be acceptable for applications of this type.
- D. After placing and finishing, use one or more of the following methods to preserve moisture in concrete:
 - 1. Ponding or continuous fogging or sprinkling.
 - 2. Application of mats or fabric kept continuously wet.
 - 3. Continuous application of steam (under 150 degrees Fahrenheit).
 - 4. Application of sheet materials conforming to ASTM C171.
 - 5. If approved by the Engineer, application of a curing compound in accordance with Article 3.05. Apply the compound in accordance with the manufacturer's recommendation on after water sheen has disappeared from the concrete surface and after finishing operations. The rate of application shall not exceed 200 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.
- E. Keep absorbent forms wet until they are removed. After form removal, cure concrete by one of the methods in paragraph D.
- F. Any of the curing procedures used in Paragraph 3.01-D may be replaced by one of the other curing procedures listed in Paragraph 3.01-D after the concrete is one-day old. However, the concrete surface shall not be permitted to become dry at any time.

3.02 CURING CONCRETE UNDER COLD WEATHER CONDITIONS

- A. Suitable means shall be provided for a minimum of 72 hours after placing concrete to maintain it at or above the minimum as placed temperatures specified in Article 3.02 herein.. During the 72-hour period, the concrete surface shall not be exposed to air more than 20°F above the minimum as placed temperatures.
- B. Stripping time for forms and supports shall be increased as necessary to allow for retardation in concrete strength caused by colder temperatures. This retardation is magnified when using concrete made with blended cements or containing fly ash or ground granulated blast furnace slag. Therefore, curing times and stripping times shall be further increased as necessary when using these types of concrete.

- C. The methods of protecting the concrete shall be approved by the Engineer and shall be such as will prevent local drying. Equipment and materials approved for this purpose shall be on the site in sufficient quantity before the work begins. The Contractor shall assist the Engineer by providing holes in the forms and the concrete in which thermometers can be placed to determine the adequacy of heating and protection. All such thermometers shall be furnished by the Contractor in quantity and type which the Engineer directs.
- D. Curing procedures during cold weather conditions shall conform to the requirements of ACI 306.

3.03 CURING CONCRETE UNDER HOT WEATHER CONDITIONS

- A. When air temperatures exceed 85°F, the Contractor shall take extra care in placing and finishing techniques to avoid formation of cold joints and plastic shrinkage cracking. If ordered by the Engineer, temporary sun shades and/or windbreakers shall be erected to guard against such developments, including generous use of wet burlap coverings and fog sprays to prevent drying out of the exposed concrete surfaces.
- B. Immediately after screeding, horizontal surfaces shall receive an application of evaporation reducer. Apply in accordance with manufacturer's instructions. Final finish work shall begin as soon as the mix has stiffened sufficiently to support the workmen.
- C. Curing and protection of the concrete shall begin immediately after completion of the finishing operation. Continuous moist-curing consisting of method 1 or 2 listed in paragraph 3.01D is mandatory for at least the first 24 hours. Method 2 may be used only if the finished surface is not marred or blemished during contact with the coverings.
- D. At the end of the initial 24-hour period, curing and protection of the concrete shall continue for at least four (4) additional days using one of the methods listed in paragraph 3.01D.
- E. Curing procedures during hot weather conditions shall conform to the requirements of ACI 305.

3.04 USE OF CURING COMPOUND

- A. Curing compound shall be used only where specifically approved by the Engineer. Curing compound shall not be used on surfaces to receive subsequent coatings. Curing compound shall never be used for curing exposed walls with fluid or earth backfill on the opposite side. A continuous wet cure for a minimum of five days is required for these applications. Curing compound shall not be used on surfaces exposed to water in potable water storage tanks and treatment plants unless curing compound is certified in accordance with ANSI/NSF Standard 61.
- B. When permitted, the curing compound shall maintain the concrete in a moist condition for the required time period, and the subsequent appearance of the concrete surface shall not be affected.
- C. The compound shall be applied in accordance with the manufacturer's recommendations after water sheen has disappeared from the concrete surface and

after finishing operations. The rate of application shall not exceed 300 square feet per gallon. For rough surfaces, apply in two directions at right angles to each other.

3.05 EARLY TERMINATION OF CURING

- A. Moisture retention measures may be terminated earlier than the specified times only when at least one of the following conditions is met:
1. The strength of the concrete reaches 85 percent of the specified 28-day compressive strength in laboratory-cured cylinders representative of the concrete in place, and the temperature of the in-place concrete has been constantly maintained at 50 degrees Fahrenheit or higher.
 2. The strength of concrete reaches the specified 28-day compressive strength as determined by accepted nondestructive methods or laboratory-cured cylinder test results.

END OF SECTION

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SECTION 03400

PRECAST CONCRETE, GENERAL

PART 1 - GENERAL

1.01 REQUIREMENTS

- A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03200 – Concrete Reinforcement
- B. Section 03300 – Cast-in-Place Concrete
- C. Section 03350 – Concrete Finishes
- D. Section 03370 – Concrete Curing
- E. Section 03315 – Grout
- F. Section 05500 – Metal Fabrications

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the end of the Bid.
 - 1. Florida Building Code
 - 2. ACI 318-Building Code Requirements for Reinforced Concrete
 - 3. PCI Standard MNL-116 - Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
 - 4. PCI Design Handbook

1.04 SUBMITTALS

- A. The Contractor shall submit the following for review in accordance with Section 01300 entitled "Submittals".
 - 1. Shop drawings for all precast concrete items showing all dimensions, locations, and type of lifting inserts, and details of reinforcement and joints.
 - 2. A list of the design criteria used by the manufacturer for all manufactured, precast items.

3. Design calculations, showing at least the design loads and stresses on the item, shall be submitted. Calculations shall be signed and sealed by a Professional Engineer registered in the State of Florida.
4. Certified reports for all lifting inserts, indicating allowable design loads.
5. Information on lifting and erection procedures.

1.05 QUALITY ASSURANCE

- A. All manufactured precast concrete units shall be produced by an experienced manufacturer regularly engaged in the production of such items. All manufactured precast concrete and site-cast units shall be free of defects, checks, and cracks. Care shall be taken in the mixing of materials, casting, curing and shipping to avoid any of the above. The Engineer may elect to examine the units at the casting yard or upon arrival of the same at the site. The Engineer shall have the option of rejecting any or all of the precast work if it does not meet with the requirements specified herein or on the Drawings. All rejected work shall be replaced at no additional cost to the City.
- B. Manufacturer qualifications:
 1. The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute, Plant Certification Program, prior to the start of production. Certification is only required for plants providing prestressed structural members such as hollow core planks, double T members, etc.
 2. In lieu of such certification, the manufacturer shall, at his expense, meet the following requirements:
 - a. Retain independent testing or consulting firm approved by the architect/engineer and/or City.
 - b. The basis of inspection shall be the Prestressed Concrete Institute Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products, MNL-116.
 - c. This firm shall inspect the precast plant at two-week intervals during production and issue a report, certified by a registered engineer verifying that materials, methods, products and quality control meet all the requirements of the specifications, drawings, and MNL-116. If the report indicates to the contrary, the engineer, at the precaster's expense, will inspect and may reject any or all products produced during the period of non-compliance with the above requirements.
- C. Plant production and engineering must be under direct supervision and control of an Engineer who possesses a minimum of five (5) years' experience in precast concrete work.

PART 2 - PRODUCTS

2.01 CONCRETE

- A. Concrete materials including Portland cement, aggregates, water, and admixtures shall conform to Section 03300 entitled "Cast-in-Place Concrete".
- B. For prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 5,000 psi unless otherwise specified. Minimum compressive strength of concrete at transfer of prestressing force shall be 3,500 psi.
- C. For non-prestressed concrete items, minimum compressive strength of concrete at 28 days shall be 4,000 psi unless otherwise specified.

2.02 GROUT

- A. Grout for joints between panels shall be a non-shrink, non-metallic grout in conformance with Section 03315 entitled "Grout".
- B. Minimum compressive strength of grout at 7 days shall be 3,000 psi.

2.03 REINFORCING STEEL

- A. Reinforcing steel used for precast concrete construction shall conform to Section 03200 entitled "Concrete Reinforcement".

2.04 PRESTRESSING STRANDS

- A. Prestressing strands shall be 7-wire, stress-relieved, high-strength strands Grade 250K or 270K.

2.05 STEEL INSERTS

- A. Steel inserts shall be in accordance with Section 05500 entitled "Metal Fabrications".
- B. All steel inserts protruding from or occurring at the surface of precast units shall be galvanized in accordance with Section 05035 entitled "Galvanizing".

2.06 WELDING

- A. Welding shall conform to Section 05500 entitled "Metal Fabrications".

2.07 BEARING PADS

- A. Plastic bearing pads shall be multi-monomer plastic strips which are non-leaching and support construction loads with no visible overall expansion, manufactured specifically for the purpose of bearing precast concrete.

PART 3 - EXECUTION

3.01 FABRICATION AND CASTING

- A. All precast members shall be fabricated and cast to the shapes, dimensions and lengths shown on the Drawings and in compliance with PCI MNL-116. Precast

members shall be straight, true and free from dimensional distortions, except for camber and tolerances permitted later in this clause. All integral appurtenances, reinforcing, openings, etc., shall be accurately located and secured in position with the form work system. Form materials shall be steel and the systems free form leakage during the casting operation.

- B. All cover of reinforcing shall be the same as detailed on the Drawings.
- C. Because of the critical nature of the bond development length in prestressed concrete panel construction, if the transfer of stress is by burning of the fully tensioned strands at the ends of the member, each strand shall first be burned at the ends of the bed and then at each end of each member before proceeding to the next strand in the burning pattern.
- D. The Contractor shall coordinate the communication of all necessary information concerning openings, sleeves, or inserts to the manufacturer of the precast members.
- E. Concrete shall be finished in accordance with Section 03350 entitled "Concrete Finishes". All recesses due to cut tendons shall be grouted.
- F. Curing of precast members shall be in accordance with Section 03370 entitled "Concrete Curing".
- G. The manufacturer shall provide lifting inserts.

3.02 HANDLING, TRANSPORTING AND STORING

- A. Precast members shall not be transported away from the casting yard until the concrete has reached the minimum required 28 day compressive strength and a period of at least five (5) days has elapsed since casting, unless otherwise permitted by the Engineer.
- B. No precast member shall be transported from the plant to the job site prior to approval of that member by the plant inspector. This approval will be stamped on the member by the plant inspector.
- C. During handling, transporting, and storing, precast concrete members shall be lifted and supported only at the lifting or supporting points as indicated on the shop drawings.
- D. All precast members shall be stored on solid, unyielding, storage blocks in a manner to prevent torsion, objectionable bending, and contact with the ground.
- E. Precast concrete members shall not be used as storage areas for other materials or equipment.
- F. Precast members damaged while being handled or transported will be rejected or shall be repaired in a manner approved by the Engineer.

3.03 ERECTION

- A. Erection shall be carried out by the manufacturer or under his supervision using labor, equipment, tools and materials required for proper execution of the work.

- B. Contractor shall prepare all bearing surfaces to a true and level line prior to erection. All supports of the precast members shall be accurately located and of required size and bearing materials.
- C. Installation of the precast members shall be made by leveling the top surface of the assembled units keeping the units tight and at right angles to the bearing surface.
- D. Connections which require welding shall be properly made in accordance with Section 05050 entitled "Metal Fastening".
- E. Grouting between adjacent precast members and along the edges of the assembled precast members shall be accomplished as indicated on the drawings, care being taken to solidly pack such spaces and to prevent leakage or droppings of grout through the assembled precast members. Any grout which seeps through the precast members shall be removed before it hardens.
- F. In no case shall concentrated construction loads, or construction loads exceeding the design loads, be placed on the precast members. In no case shall loads be placed on the precast members prior to the welding operations associated with erection, and prior to placing of topping (if required).
- G. No Contractor, Subcontractor or any of his employees shall arbitrarily cut, drill, punch or otherwise tamper with the precast members.
- H. Precast members damaged while being erected will be rejected or shall be repaired in a manner approved by the Engineer.

END OF SECTION

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SECTION 03480

PRECAST CONCRETE MANHOLES, HANDHOLES AND VAULTS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall construct all precast concrete items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03400 – Precast Concrete, General

1.03 QUALITY CONTROL

- A. Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code (FBC) and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this section:

1. ASTM C478 Specification for Precast Reinforced Concrete Manhole Sections.
2. ACI 318 Building Code Requirements for Reinforced Concrete.

1.04 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Specification Section 01300 – Submittals.
- B. In addition to the items listed in Section 03400 – Precast Concrete, General, Shop Drawings shall include, but not be limited to:
 1. Piping and conduit sheets
 2. Complete layout and installation Drawings and schedules with clearly marked dimensions.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE MANHOLES, VAULTS, AND METER BOXES

- A. Precast concrete manholes, vaults, and meter boxes, shall conform to ASTM C478 except as modified herein, and shall be furnished with waterstops, sleeves and openings as noted on the Drawings. Reinforcement, if shown, shall be as shown on the Drawings. Tapered top sections shall be supplied where they are shown on the drawings, or where they are otherwise indicated to be necessary.

1. The design and manufacture of the sections shall be based on H-20 traffic loading.

2. Reinforcement shall conform to the requirements of the Section 03200 entitled "Concrete Reinforcement".
3. Minimum wall thickness shall be eight inches.
4. Cement shall be ASTM C150, Type II.
5. The date and name of manufacturer shall be marked inside each precast section.
6. Joints between manhole riser sections and at base slabs shall be groove type. Joints shall be sealed with two (2) individual self sealing butyl rubber gaskets conforming to Federal Specification No. SS-5-00210. The gasket material shall be Kent Seal.

2.02 PIPE CONNECTIONS

- A. The precast reinforced concrete manhole base shall be provided with circular openings at the locations and elevations for the proper connection of all pipes. The pipe connections shall be sealed with either a flexible manhole seal assembly or with mortar.
- B. When a flexible manhole seal assembly is used to seal the pipe connection, the seal assembly shall be installed in accordance with the recommendations of the seal assembly manufacturer and shall conform to ASTM C923.
- C. Flexible manhole seal assemblies shall permit at least an eight (8) degree deflection from the center line of the opening in any direction while maintaining a watertight connection.
- D. The flexible manhole seal assembly shall be manufactured by Interpace Corp (Lock Joint Flexible Manhole Sleeve), National Pollution Control Systems, Inc. (Kor-N-Seal) or Press-Seal Gasket Corp. Manhole seal assemblies produced by other manufacturers will be considered for use by Engineer if submitted by the Contractor. Such manhole seal assemblies shall be acceptable only if the Shop Drawings are approved.
- E. Short lengths of sewer pipe shall be installed entering and leaving the precast manhole base. These short lengths of pipe shall have a maximum length of 3'3". A concrete cradle shall be placed under the short length of pipe in accordance with the dimensions shown on the Drawings.
- F. The concrete cradle is not necessary when a flexible manhole seal assembly is used.

2.03 MANHOLE LADDERS

- A. Manhole ladders shall conform to Section 06610, Glass Fiber and Resin Fabrications.

2.04 SITE-CAST ITEMS

- A. Where removable concrete slabs are required by the drawings, they shall conform to the requirements set forth in Section 03300 entitled "Cast-in-Place Concrete." All thicknesses, reinforcing, and edge clearances shall be as shown on the drawings.

2.05 MORTAR

- A. Mortar used between the sections of precast concrete manholes and vaults shall be as recommended by the section manufacturer, subject to the requirements of Division 4.

2.06 NON-SHRINK GROUT

- A. Non-shrink grout shall be as specified in Section 03315 entitled "Grout".

PART 3 - EXECUTION

3.01 MANUFACTURED ITEMS

A. Precast Concrete Manhole Sections

- 1. Precast concrete manhole sections shall be set so as to be vertical, with sections in true alignment. The joint of the previously set section shall be covered with mortar and preformed joint sealant before the next section is placed. Before the mortar is set, joints shall be pointed, and exterior joints shall be thoroughly tooled so as to be slightly concave with a hard polished surface, free of cracks. Interior joints shall be tooled flush in a similar manner.

B. Miscellaneous Precast Vaults

- 1. All pull boxes, electrical manholes, vaults, meterboxes and other miscellaneous precast concrete boxes shall be installed in accordance with the manufacturer's recommendations, unless otherwise required by the drawings.

3.02 SITE CAST ITEMS

- A. Where removable concrete slabs are required by the drawings, they shall be fabricated in accordance with Section 03300 entitled "Cast-in-Place Concrete".
- B. Sealant, as specified in the Section 07920 entitled "Sealants and Caulking" shall be provided all around the panels.

END OF SECTION

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SECTION 04220

CONCRETE BLOCK MASONRY

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall construct all concrete masonry Work for the project, complete, including furnishing, fabricating, and placing of required reinforcing steel and the furnishing and setting of embedded items and all other appurtenant work, all in accordance with the requirements of the Contract Documents. The Contractor is responsible for coordinating the Work of this section with that of other trades.
- B. All concrete block masonry that contains empty cells after installation shall be provided with a foamed-in-place insulation specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 - Submittals
- B. Section 03300 - Cast in Place Concrete

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all Work specified herein shall conform to or exceed the requirements of the Florida Building Code (FBC) and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
- B. Products and their installation shall be in accordance with the following trade standards, as applicable:
 - 1. Masonry Design Manual (MDM) shall mean the Masonry Design Manual published by the Masonry Industry Advancement Committee.
 - 2. Manufacturer's published recommendations and specifications.
 - 3. Federal Specifications (FS) as reference herein.
 - 4. American Society for Testing and Materials (ASTM) Specifications, as referenced herein.
 - 5. "Specifications for the Design and Construction of Load Bearing Concrete Masonry" published by the National Concrete Masonry Assoc., P.O. Box 9185, Rosslyn Station, Arlington, VA.
 - 6. "Building Code Requirements for Concrete Masonry Structures" (ACI 530/ASCE 5).
 - 7. "Specifications for Masonry Structures" (ACI 530.1/ASCE 6).

1.04 CONTRACTOR SUBMITTALS

- A. If requested, samples of concrete masonry unit (CMU) color ranges for each texture, as specified under products, shall be submitted to the Engineer for selection of color. Full size samples of the blocks selected shall be submitted for final review by the Engineer after color selection.
- B. Submit compressive test reports of concrete block units satisfying the design strength requirements noted on the drawings and a notarized affidavit that the block units conform to the requirements of this Section.
- C. Samples of mortar colors shall be submitted for color selection by the Engineer.
- D. Submit manufacturer's product data and installer's detailed descriptive plans for installing the foamed-in-place wall insulation. The insulation shall be installed by installers certified by the manufacturer. Submit manufacturer certification of the installer contracted to perform the work.
- E. Manufacturer's literature indicating mortar strength and composition.
- F. Submit shop drawings for precast concrete lintels.
- G. Mortar mix and water repellent admixture.
- H. Reinforcements.
- I. Ties.
- J. Control joint filler (with manufacturer's literature).
- K. Grout mix design - Quantities listed in the mix design shall be listed both by weight and by bulk volume for each component.
- L. Accessories.
- M. The Contractor through the manufacturer of the concrete masonry units shall furnish certificates, in triplicate, prior to delivery of any units to the jobsite. Each certificate shall be signed by an authorized officer of the manufacturing company and shall contain the name and address of the Contractor, the project location, the quantities, and date or dates of shipment and delivery to which the certificate applies. Units shall be certified for conformance with these Specifications.
- N. Cold and/or hot weather construction procedures in accordance with ACI 530.1/ASCE 6 sections 2.3.2.2. and 2.3.2.3.
- O. Cleaning procedures and cleaner for each masonry type.
- P. Shop Drawings, Reinforced Unit Masonry: Submit shop drawings for fabrication, bending, and placement of reinforcing bars. Shop drawings shall comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Shop drawings shall include bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcing for unit masonry work.

1.05 QUALITY ASSURANCE

- A. Before any masonry is laid, a sample panel shall be constructed for approval by the Engineer. The sample panel shall be 6 feet wide by 4 feet high, showing the CMU face, reinforcement, grouting, and type, color and tooling of mortar and bond. The approved wall sample panel shall remain in place for the duration of all masonry work, to serve as the standard of reference for all masonry. The sample panel shall be removed by the Contractor at the completion of the project.
- B. The City reserves the right to test materials for compliance with these specifications. Sampling and testing will be done in accordance with ASTM standards by an independent testing agency employed by the City. Materials that fail to meet requirements are considered defective. Subsequent tests to establish compliance (of the same or new materials) shall be paid for by the Contractor.
 - 1. Mortar testing shall be performed in accordance with ASTM C 109.
 - 2. Masonry grout testing shall be performed in accordance with ASTM C 1019.

1.06 SHIPPING, HANDLING, AND STORAGE

- A. All mortar materials shall be delivered, stored, and handled so as to prevent damage, deterioration, or contamination. All materials shall be stored under cover in a dry place and in the original packaging.
- B. All concrete masonry units shall be stored under cover, in a dry place and in a manner to prevent damage, breakage, or staining. Blocks shall be delivered to the site dry, in conformance with the specification limitation for moisture content, and kept dry by storing off the ground and under cover. Blocks which have become wet shall be removed from the site by the Contractor.
- C. All accessories shall be delivered to the site and stored in the manufacturers' original packaging. All materials shall be stored above ground and under weathertight cover.

PART 2 - PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. General
 - 1. All concrete masonry units shall be load bearing blocks conforming to ASTM C 90. Units shall be normal weight units unless shown or specified otherwise. Block shall be smooth finish block. Net area compressive strength of concrete masonry units shall be a minimum of 1,900 psi when tested in accordance with ASTM C 140. Compressive strength F'_m shall be minimum of 1500 psi in accordance with ACI 530.1 when these units are tested with the mortar specified, unless otherwise indicated on the structural drawings. Reinforced wall units shall be 2 cell end blocks with cells aligned vertically when constructed.
 - 2. All units shall be obtained from one manufacturer to ensure even color and texture throughout.

3. Nominal face dimensions shall be 8 inch by 8 inch by 16 inch, 12 inch by 8 inch by 16 inch, or "U" shaped CMU as indicated on the Drawings.
4. All bond beam, corner, lintel, sill, and other specially shaped blocks shall be provided and used where required or necessary. Specially shaped nonstructural blocks may be constructed by sawcutting. Color and texture shall match that of the adjacent units.

B. Sound Absorptive Concrete Masonry Units

1. Sound absorptive concrete masonry units shall be used to construct walls or partitions as indicated on the Drawings.
2. Sound absorptive concrete masonry units shall be Soundblox made on standard block machines using molds furnished by the Proudfoot Company, Inc., Greenwich, Connecticut; or equal. Units shall meet the requirements of ASTM C 90.
3. Soundblox units shall be 8-inch by 8-inch by 16-inch (nominal), and Type RSC as shown on the Drawings.
4. The filler elements shall be installed at the block plant and be fabricated of noncombustible fibrous material. The fillers shall have metal septa laminated to one side of the fibrous material and shall be installed with the septa facing away from the slots. The filler and the septa shall be cut accurately to size, and installed as recommended.

- C. Fire-Rated Units: Masonry units for fire-rated walls shall comply with the requirements of Paragraph 2.01, A above and Underwriter's Laboratory requirements for fire rating as shown on the Drawings.

2.02 MORTAR AND GROUT

- A. Mortar shall be Type "M" mortar with average compressive strength at 28 days of 2,500 psi; in accordance with ASTM C 270.
- B. The mortar shall be dry mixed to laboratory established proportions with only as much water added as required to produce a workable mix.
- C. Hydrated lime shall conform to the requirements of ASTM C 207, Type "S", domestic manufactured.
- D. Sand shall be clean, durable particles, free from injurious amounts of organic matter. The sand shall conform to the requirements of ASTM C 144.
- E. Water shall be from a potable source, suitable for domestic consumption.
- F. Admixture for the mortar shall be Master Builders "Omicron Mortarproofing"; Sika Chemical Company "Sika Red Label"; or equal. The admixture shall not be detrimental to the bonding of the mortar.
- G. Masonry Grout shall conform to the requirements of ASTM C 476 and ACI 530.1. Grout shall be plant batched peagravel 3000 psi 28 day compressive strength.
- H. Sand for grout shall conform to ASTM C 404 or ASTM C 33, as required.

- I. Admixture for grout shall be Sika Chemical Company "Sika Grout Aid", Type II; Master Builders "Pozzolith", normal; or equal.

2.03 MASONRY ACCESSORIES

- A. The following list of companies manufacture products that are acceptable for this section, subject to conformance with the specified requirements: Dur O Wall Products, A.A. Wire Products; Hohman Barnard, Keystone Steel and Wire Company, or equal.
- B. Masonry Joint Reinforcement
 1. All masonry joint reinforcement shall be fabricated from cold drawn steel wire, conforming to ASTM A 82.
 2. Reinforcement shall consist of two parallel longitudinal deformed wires, not less than 8 gauge, weld connected with cross-wires, not less than 9 gauge, in a triangular pattern. For vertically reinforced walls, cross wires shall be of a rectangular pattern.
 3. Out to out spacing of the longitudinal wires shall be 2 inches less than the nominal width of the wall.
 4. The distance between the welded contacts of cross wires with each longitudinal wire shall not exceed 16 inches, staggered.
 5. Cross wires shall be in the same plane with the longitudinal wires.
 6. Reinforcement shall be provided in minimum 10 foot sections. All corners and tees shall be provided prefabricated, of the same materials as the joint reinforcement.
 7. Reinforcing bars shall conform to "Specifications for Deformed Billet Steel Bars for Concrete Reinforcement" (ASTM A 615), grade 60, except 1/4" diameter smooth bars which shall be grade 40.
- C. Anchor and Ties
 1. Anchors and ties shall be hot dip galvanized ferrous metals.
 2. Wire mesh ties shall be minimum 16 gauge, 1/2 inch mesh of steel wire. Ties shall be a minimum of 12 inches in length, and 1 inch less in width than the wall in which they are placed.
 3. Rigid steel anchors shall be 1 1/2 inch by 1/4 inch with ends turned up 1/4 inch at the outer end.
 4. Dovetail anchors shall be minimum 16 gauge, 1 inch wide, and turned up 1/4 inch at the outer end.
 5. Corrugated or crimped metal ties shall be made of steel sheet not less than 7/8 inch wide, 22 gauge in thickness, 6 inches in length.

2.04 FOAMED-IN-PLACE MASONRY WALL INSULATION

- A. Insulation shall be a two-component, foamed-in-place thermal insulation comprising of an amino-plast resin and a catalyst foaming agent surfactant that when injected into open cavities of block will flow and completely fill the open cells.
- B. Foamed-in-place insulation shall conform to the requirements of Core-Fill 500 as manufactured by Tailored Chemical Products, Hickory, NC, or approved equal. Tailored Foam of Florida, Inc., Sanford, Florida is an approved applicator of Core-Fill 500 foam insulation.
- C. Insulation shall be non-combustible, Class A building material.
- D. Insulation shall have an R value of 4.9 per inch at 32 degrees Fahrenheit per ASTM C-177.

PART 3 - EXECUTION

3.01 GENERAL

- A. All Work shall be performed in accordance with the provisions of the FBC for concrete hollow unit masonry.
- B. All masonry shall be laid plumb and true to line. Bond shall be maintained such that the horizontal or vertical alignment of the foundation shall not be more than 1 inch out of plumb.
- C. The Contractor shall set or embed in the Work all anchors, bolts, reglets, sleeves, conduits, and other items as required. Where bolts or other items are anchored into the masonry, those cells shall be grouted solid after the embedded items are in place.
- D. No construction support shall be attached to the wall except where specifically permitted by the Engineer.
- E. All masonry slots, chases, or openings required for the proper installation of the Work of other Sections shall be constructed as indicated on the Drawings, or in accordance with information furnished, prior to starting Work in those areas. No chase shall be cut into any constructed hollow unit masonry wall, except as directed or reviewed by the Engineer.
- F. Surfaces shall be brushed as Work progresses, and maintained as clean as is practicable. Unfinished Work shall be raked back where possible, and toothed only where absolutely necessary.
- G. All fresh or unfinished Work shall be fully covered and protected against rain and wind. Before continuing work, all previously laid Work shall be swept clean. The tops of walls or other unfinished Work shall be protected against all damage by means of waterproof paper, tarpaulins, boards, or other means satisfactory to the Engineer.
- H. Anchors and ties shall be placed a minimum of 16 inches vertically and 24 inches horizontally, unless otherwise indicated. Anchors and ties for masonry shall be provided into adjacent concrete walls, columns, or beams at the above specified spacings.

- I. Over plumbing and pounding shall be avoided, at corners and jambs, for fitting stretcher units after they are set in position. Where adjustment must be made after mortar has started to harden, the mortar shall be removed and replaced with fresh mortar.
- J. Concrete brick shall be used to course out walls which are concealed in the finished work.
- K. Masonry units shall be cut straight, and true, using power masonry saws.
- L. Cold and hot weather construction
 - 1. No masonry shall be erected when ambient temperature has dropped below 45° F unless it is rising and at no time when it has dropped below 40° F. Provisions shall be made for heating and drying of materials, and the complete work shall be protected in accordance with ACI 530.1 section 1.8C. Masonry shall not be laid with ice or frost on its surfaces, and no masonry shall be laid on frozen work. Any work which freezes before the mortar has set shall be removed and replaced at the Contractor's own expense. Do not use any admixtures or antifreeze in the mortar.
 - 2. When temperature is above 100° F or 90° F with a wind velocity greater than 8 MPH, mortar beds shall be spread no more than 4 feet ahead of masonry and masonry shall be set within one minute of spreading mortar.

3.02 LAYOUTS

- A. The Contractor shall lay out the coursing horizontally and vertically, as shown on the Drawings.
- B. Block cuts less than 4 inches wide shall be avoided.
- C. Vertical coursing shall be 8 inches, with 3/8 inch thick mortar joints.
- D. Bed joints shall be indicated to receive masonry joint reinforcing, ties, and/or anchors.

3.03 REINFORCING

- A. All reinforced horizontal joints shall be reinforced continuously with ends lapped 8 inches, and laps staggered vertically. Horizontal reinforcing shall have a vertical spacing of 16 inches on center unless noted otherwise. Prefabricated corners and tees shall be provided at all horizontal wall intersections.
- B. Reinforcing shall be provided in the bed joints immediately above and below all masonry openings.
- C. Mortar joints with wire reinforcement shall be at least twice the thickness of the wire.
- D. Where knock out openings are indicated on the Drawings, no steel or joint reinforcement shall run continuously through the openings.
- E. Prior to placing metal reinforcing, anchors, and ties, all loose rust, tie wires, tags and all other foreign matter that may reduce bond shall be removed.

- F. Reinforcing shall be placed as indicated on the Drawings and general notes. Place a minimum of two No. 5 bars in each bond beam or lintel, and a minimum of one No. 5 bar at all jambs, corners, intersections and wall ends of concrete blockwalls, whether indicated or not. Lintels shall extend 8 inches past the openings. Lap reinforcing bars 48 diameters or 30 inches minimum at splices. All cells containing reinforcing shall be filled solid with grout.
- G. When a dowel does not line up with a vertical core, it shall not be sloped more than 1 horizontal in 6 vertical. Dowels shall be grouted into a core in vertical alignment, even though they are in adjacent cell to the vertical wall reinforcing.

3.04 BOND AND JOINTS

- A. All masonry units shall be laid in running bond by lapping units in successive courses a distance of one half unit.
- B. The starting joint of foundations and floor slab shall be laid with full mortar coverage on the bed except that the area where grout occurs shall be kept free from mortar so that the grout will bond (contact) with concrete already placed.
- C. All courses shall be level, with joints of uniform width. Units shall have full mortar coverage of the face shells in both the horizontal and vertical joints. Reinforced cells shall have mortar coverage on cross webs also to prevent grout leakage to adjacent cells.
- D. All joints shall be pointed solid with mortar on both sides and wall of block. Joints in exposed Work shall be finished concave with finishing tool, to create a dense surface. Interior and exterior joints in nonexposed or plaster covered masonry shall be flush.
- E. All sound absorptive concrete masonry units shall be laid in stack bond with the open ends of the cavities facing downward, and shall be seated in a full bed of mortar.
- F. Slots shall be provided to expose the areas where sound absorption is desired, as indicated on the Drawings. Care shall be taken to ensure that the slots are kept free of mortar or debris above mortar joints.

3.05 CONTROL JOINTS

- A. Control joints shall be installed as detailed and where shown on the Drawings or needed.
- B. The maximum horizontal distance between vertical control joints shall be 30 feet, but joints shall be located only as reviewed by the Engineer or as shown.
- C. Joints shall be equal in width to the standard mortar joints.
- D. Horizontal joint reinforcing shall be discontinuous at control joints.

3.06 MORTAR AND GROUT

- A. All equipment used in placing, moving, and storing mortar shall be thoroughly cleaned at the end of each day's work.
- B. Mortar that, in the opinion of the Engineer, has begun to set shall not be used.

- C. All courses shall be laid in full mortar beds. All units shall be laid with mortar applied to the face shells of blocks previously laid, as well as to blocks being laid, to ensure well filled joints.
- D. Where new masonry is joined to existing or partially set work, loose mortar and joints shall first be cleaned. When it is necessary to stop a horizontal run, rack back one half block length in each course; toothing shall not be permitted.
- E. Hollow metal frames, mullions, and spaces around built in items shall be filled solidly with grout.
- F. Proportioning and Mixing of Mortar
 - 1. Measurement of materials shall be such that the specified proportions are controlled and accurately maintained.
 - 2. Workability of consistency of the mortar on the board shall be sufficiently wet to be worked under the trowel. Water for tempering shall be available on the scaffold at all times. Mortar which has begun to set after initial mixing shall be discarded. Mortar which has stiffened due to evaporation shall be retempered to restore its workability. Retempering the mortar at the mixer shall not be permitted.
 - 3. Mortar shall be machine mixed in a type of mortar mixer which is acceptable to the Engineer, and in which the quantity of water can be accurately and uniformly controlled.
 - 4. The mixing time shall not be less than 5 minutes, approximately 2 minutes of which shall be for mixing the dry materials, and not less than 3 minutes for continuing the mixing after the water has been added.
 - 5. Where hydrated lime is used for mortar requiring a lime content, the Contractor has the option of using the dry mix method or first converting the lime into a putty. Where the dry mix method is employed, the materials for each batch shall be well turned over together until the even color of the mixed, dry materials indicates that the cementitious materials have been thoroughly distributed throughout the mass. After this point, the water shall be gradually added.
- G. Mortar and grout drippings shall be cleaned from exposed masonry and adjacent surfaces immediately, to prevent surfaces from being permanently stained. Drippings and smears shall be removed before mortar and/or grout sets or hardens. Mortar extruded beyond faces of walls or partitions shall be removed.
- H. Grouting
 - 1. Grouting shall not be started until walls have cured a minimum of 24 hours.
 - 2. Reinforcing steel shall be secured in place and inspected before grouting starts. Inform Engineer for inspection.
 - 3. Mortar drippings shall be kept out of the grout space.
 - 4. Vertical cells to be filled shall have vertical alignment to maintain a continuous unobstructed cell area not less than 2 inches by 3 inches.

5. All cells to be grouted including those with reinforcing shall be solidly filled with grout. Consolidate at time of pouring by puddling (rodding) or vibrating with mechanical vibrators and reconsolidate again after 5 to 10 minutes and no later than 20 minutes to allow water absorption by concrete block.
6. Grout shall be consolidated by puddling or mechanical vibrating during placement, and reconsolidated after excess moisture has been absorbed, but before plasticity is lost.
7. All anchor bolts and other embedded items shall be securely held in place during the grouting operation.
8. Grouting shall be done in pours no exceeding 10 feet and lifts of a maximum of 5 feet. Provide pre-cut full block height clean out holes at the first course of all cores containing vertical reinforcement. As successive masonry lifts are laid, remove mortar dripping from the grout space and off the reinforcing steel. Prior to grouting and boarding the cleanout opening, remove all leftover mortar drippings and loose materials and flush out the reinforced cell with water. Board up the opening only after Engineer's inspection and approval.
- I. Installation of all masonry accessories shall be in strict accordance with manufacturer's recommendations for the particular product. In the event that no specific installation instructions are provided by the manufacturer, accepted industry standard shall be adhered to.

3.07 INSULATION

- A. Install foamed-in-place insulation in ungrouted cells of masonry units where shown and/or noted on the drawings.
- B. The foamed-in-place insulation shall be pressure injected through a series of 5/8-inch to 7/8-inch holes drilled into every vertical column of block cells beginning at an approximate height of four feet from the finished floor level. Holes shall be patched with mortar and scored to resemble existing surface.
- C. Foamed-in-place insulation shall be placed prior to installation of interior finish work, after all masonry and structural concrete work is in place, and once moisture content of in-place CMU is acceptable to the manufacturer. Installation shall comply with manufacturer's instructions.
- D. Remove excess materials and debris promptly. Remove mortar drippings from masonry and adjacent work before final set.
- E. All holes and openings in the wall through which insulation can escape shall be permanently sealed or caulked prior to installation of the insulation. Copper, galvanized steel, or fiber glass screening shall be used in all weep holes.

3.08 BUILT-IN WORK

- A. Furnish and install all anchor bolts, access doors and frames, and all metal work to be built into masonry which is not specified to be furnished under any other heading of the Specifications.

- B. The masonry Contractor shall thoroughly familiarize himself with all the requirements of the structural steel and reinforced concrete work and specifications, and he must make his own work conform to the requirements therein illustrated or described. He shall build in all the structural steel and miscellaneous iron work of every description.
- C. Thoroughly tie in all anchors and secure masonry work to the concrete work in a careful manner. All pockets and openings must be filled solidly with mortar so as to leave no air space or pockets to collect moisture. No iron work shall be covered or built-in unless thoroughly painted by the Contractor setting it.
- D. The masonry Contractor shall build-in items furnished by others.
- E. The masonry Contractor shall coordinate his work with mechanical and electrical trades in order to accommodate all built-in pipes and conduits.

3.09 LINTELS

- A. Furnish and install precast reinforced concrete lintel at all openings in masonry walls not having poured lintel or tie beam at top. Provide 8" minimum bearing either side of opening. Bottom flange of precast lintels shall be pre-cut at bearing to allow passage of reinforcing and grout.

3.10 CLEANING AND POINTING

- A. All masonry to be left exposed shall be cleaned thoroughly with 5 percent muriatic acid solution using stiff brush and rinse thoroughly with clear water.
- B. Point all holes and chipped areas in exposed masonry. Cut out defective joints and tuck pointed solidly with like mortar.
- C. Remove all loose and excess mortar prior to cleaning.

3.11 PARGING

- A. Parge masonry walls where shown or indicated on the drawings in two uniform coats of mortar. Maintain 3/4 inch total thickness.
- B. Dampen masonry walls prior to application.
- C. Scarify base coat to ensure full bond to subsequent coat.
- D. Steel trowel surface smooth and flat.

END OF SECTION

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SECTION 05010
METAL MATERIALS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Metal materials not otherwise specified shall conform to the requirements of this Section.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Materials for fasteners are included in Section 05050 entitled "Metal Fastening".
- B. Requirements for specific products made from the materials specified herein are included in other sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. ASTM A36 Standard Specification for Structural Steel
- B. ASTM A47 Standard Specification for Malleable Iron Castings
- C. ASTM A48 Standard Specification for Gray Iron Castings
- D. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- E. ASTM A167 Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- F. ASTM A276 Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
- G. ASTM A307 Standard Specification for Carbon Steel Externally Threaded Standard Fasteners
- H. ASTM A446 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) quality
- I. ASTM A500 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
- J. ASTM A501 Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
- K. ASTM A529 Standard Specification for Structural Steel with 42 000 psi (290 Mpa) Minimum Yield Point (1/2 in. (12.7 mm) Maximum Thickness)
- L. ASTM A536 Standard Specification for Ductile Iron Castings

- M. ASTM A570 Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
- N. ASTM A572/ Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
- O. ASTM A666 Standard Specification for Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar for Structural Applications
- P. ASTM A992 Standard Specification for Structural Steel Shapes
- Q. ASTM A1085 Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS)
- R. ASTM B26 Standard Specification for Aluminum-Alloy Sand Castings
- S. ASTM B85 Standard Specification for Aluminum-Alloy Die Castings
- T. ASTM B108 Standard Specification for Aluminum-Alloy Permanent Mold Castings
- U. ASTM B138 Standard Specification for Manganese Bronze Rod, Bar, and Shapes
- V. ASTM B209 Standard Specification for Aluminum-Alloy Sheet and Plate
- W. ASTM B221 Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
- X. ASTM B308 Standard Specification for Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
- Y. ASTM B574 Standard Specification for Nickel-Molybdenum-Chromium Alloy Rod
- Z. ASTM F468 Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use
- AA. ASTM F593 Standard Specification for Stainless Steel Fasteners

1.04 SUBMITTALS

- A. Material certifications shall be submitted along with any shop drawings for metal products and fabrications required by other sections of the Specifications.

1.05 QUALITY ASSURANCE

- A. City may engage the services of a testing agency to test any metal materials for conformance with the material requirements herein. If the material is found to be in conformance with Specifications the cost of testing will be borne by the City. If the material does not conform to the Specifications, the cost of testing shall be paid by the Contractor and all materials not in conformance as determined by the Engineer shall be replaced by the Contractor at no additional cost to the City. In lieu of replacing

materials the Contractor may request further testing to determine conformance, but any such testing shall be paid for by the Contractor regardless of outcome of such testing.

PART 2 - PRODUCTS

2.01 CARBON AND LOW ALLOY STEEL

A. Material types and ASTM designations shall be as listed below:

1. Steel W Shapes ASTM A 992
2. Steel S, M, C, MC Shapes and Angles, Bars, and Plates ASTM A 36
3. Steel HP Shapes ASTM A 572, Grade 50
4. Rods ASTM F 1554 Grade 36
5. Pipe – Structural Use ASTM A53 Grade B
6. Hollow Structural Sections ASTM A500 Grade C or A1085
7. Cold-Formed Steel Framing ASTM A 653

2.02 STAINLESS STEEL

A. All stainless steel fabrications shall be Type 316.

B. Material types and ASTM designations are listed below:

1. Plates and Sheets ASTM A167 or A666 Grade A
2. Structural Shapes ASTM A276
3. Fasteners (Bolts, etc.) ASTM F593

2.03 ALUMINUM

A. All aluminum shall be alloy 6061-T6, unless otherwise noted or specified herein.

B. Material types and ASTM designations are listed below:

1. Structural Shapes ASTM B308
2. Castings ASTM B26, B85, or B108
3. Extruded Bars ASTM B221 - Alloy 6061
4. Extruded Rods, Shapes and Tubes ASTM B221 - Alloy 6063
5. Plates ASTM B209 - Alloy 6061
6. Sheets ASTM B221 - Alloy 3003

C. All aluminum structural members shall conform to the requirements of Section 05140 entitled "Structural Aluminum".

- D. All aluminum shall be provided with mill finish unless otherwise noted.
- E. Where bolted connections are indicated, aluminum shall be fastened with Type 316 stainless steel bolts.
- F. Aluminum in contact with dissimilar materials shall be insulated with an approved dielectric.

2.04 CAST IRON

A. Material types and ASTM designations are listed below:

- 1. Gray ASTM A48 Class 30B
- 2. Malleable ASTM A47
- 3. Ductile ASTM A536 Grade 60-40-18

2.05 BRONZE

A. Material types and ASTM designations are listed below:

- 1. Rods, Bars and Sheets ASTM B138 - Alloy B Soft

2.06 HASTELLOY

A. All Hastelloy shall be Alloy C-276.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 05050
METAL FASTENING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials, labor, and equipment required to provide all metal welds and fasteners not otherwise specified, in accordance with the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05035 - Galvanizing
- C. Section 05120 - Structural Steel
- D. Section 05140 - Structural Aluminum

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of the other requirements of the specifications, all work herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of Bid.
 - 1. Florida Building Code
 - 2. AC 193 Acceptance Criteria for Mechanical Anchors in Concrete Elements
 - 3. AC 308 Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements
 - 4. ACI 318 Building Code Requirements for Structural Concrete
 - 5. ACI 355.2 Qualifications of Post-Installed Mechanical Anchors in Concrete
 - 6. ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete
 - 7. AISC 348 The 2009 RCSC Specification for Structural Joints
 - 8. AISC Code of Standard Practice
 - 9. AWS D1.1 Structural Welding Code - Steel
 - 10. AWS D1.2 Structural Welding Code – Aluminum
 - 11. AWS D1.6 Structural Welding Code – Stainless Steel

12. Aluminum Association Specifications for Aluminum Structures
13. ASTM A572/A572M-94C Standard Specification for High Strength Low-Alloy Columbium-Vanadium Structural Steel Grade 50
14. ASTM A36 Standard Specification for Carbon Structural Steel
15. ASTM A325 Standard Specification for High-Strength Bolts for Structural Steel Joints
16. ASTM A489 Standard Specification for Eyebolts
17. ASTM A490 Standard Specification for Quenched and Tempered Alloy Steel Bolts for Structural Steel Joints
18. ASTM A563 Standard Specifications for Carbon and Alloy Steel Nuts
19. ASTM D1785 Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe
20. ASTM E488 Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
21. ASTM F436 Standard Specification for Hardened Steel Washers
22. ASTM F467 Standard Specification for Nonferrous Nuts for General Use
23. ASTM F593 Standard Specification for Stainless Steel Bolts; Hex Cap Screws, and Studs
24. ASTM F594 Standard Specification for Stainless Steel Nuts
25. ASTM F1554 Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

1.04 SUBMITTALS

- A. Submit the following items in accordance with Section 01300 entitled "Submittals":
 1. Shop Drawings providing the fastener's manufacturer and type and certification of the fastener's material and capacity.
 2. Anchor design calculations sealed by a Professional Engineer currently registered in the State of Florida. Only required if design not shown on Contract Drawings.
 3. Manufacturer's installation instructions.
 4. Welder certifications for each person who is to perform field welding. Certifications shall be from a recognized testing laboratory.
 5. Certified weld inspection reports, when required.
 6. Welding procedures.
 7. Installer qualifications.
 8. Certification of Installer Training.

9. Inspection Reports.
10. Results of Anchor Proof Testing.
11. For outdoor equipment, anchorage calculations to resist design wind loads, signed and sealed by a Professional Engineer registered in the State of Florida.

1.05 QUALITY ASSURANCE

- A. Fasteners not manufactured in the United States shall be tested and certification provided with respect to specified quality and strength standards. Certifications of origin shall be submitted for all U.S. fasteners supplied on the project.
- B. Installer Qualifications: All concrete anchors shall be installed by an Installer with at least three years of experience performing similar installations. Installer shall be certified as an Adhesive Anchor Installer in accordance with ACI-CRSI Adhesive Anchor Installation Certification Program.
- C. Installer Training: For concrete adhesive anchors, conduct a thorough training with the manufacturer or the manufacturer's representative for the Installer on the project. Training shall consist of a review of the complete installation process for drilled-in anchors, to include but not be limited to the following:
 1. Hole drilling procedure.
 2. Hole preparation and cleaning technique.
 3. Adhesive injection technique and dispenser training/maintenance.
 4. Rebar doweling preparation and installation.
 5. Proof loading/torquing.
- D. All steel welding shall be performed by welders certified in accordance with AWS D1.1. All aluminum welding shall be performed by welders certified in accordance with AWS D1.2. All stainless steel welding shall be performed by welders certified in accordance with AWS D1.6. Certifications of field welders shall be submitted prior to performing any field welds.
- E. Welds and high strength bolts used in connections of structural steel will be visually inspected in accordance with Article 3.04 of this Section.
- F. The City may engage an independent testing agency to perform testing of welded connections and to prepare test reports in accordance with AWS. Inadequate welds shall be corrected or redone and retested to the satisfaction of the Engineer and/or an acceptable independent testing laboratory, at no additional cost to the City.
- G. Provide a welding procedure for each type and thickness of weld. For welds that are not prequalified, include a Performance Qualification Report. The welding procedure shall be given to each welder performing the weld. The welding procedure shall follow the format in Annex E of AWS D1.1 with relevant information presented.
- H. Inspections of the adhesive dowel system shall be made by the Engineer or other representatives of the City in accordance with the requirements of the ESR published

by the manufacturer. Provide adequate time and access for inspections of products and anchor holes prior to injections, installation, and proof testing.

PART 2 - PRODUCTS

2.01 ANCHOR RODS (ANCHOR BOLTS)

- A. For all conditions throughout this Contract, all anchor bolts shall be Type 316 stainless steel conforming to ASTM F-593 unless noted otherwise.
- B. Nuts shall conform to ASTM F-594, alloy 316.
- C. Where anchor rods are used to anchor galvanized steel or are otherwise specified to be galvanized, anchor rods and nuts shall be hot-dip galvanized. Galvanized anchor rods shall conform to ASTM F1554 Grade 36, and nuts shall conform to ASTM A563 Grade A.
- D. Where pipe sleeves around anchor rods are shown on the Drawings, pipe sleeves shall be cut from Schedule 80 PVC plastic piping meeting the requirements of ASTM D1785, unless noted otherwise.
- E. Equipment manufacturers, fabricators, and suppliers shall design and furnish anchor bolts as required to install the supplied units. The anchor bolt layout shall be coordinated with concrete work as specified herein.
- F. Drilled in type anchor bolts, either adhesive types or mechanical types shall not be used unless approved in writing by the manufacturer/fabricator of equipment or covers, subject to acceptance by the Engineer. All operating pieces of equipment such as pumps, generators, motors etc. shall not be anchored with wedge anchors or other mechanical anchors. Drilled in type anchor bolts shall be Type 316 stainless steel. Drilled in type anchor bolts are specified under Article 2.04 of this Section entitled "Concrete Anchors".

2.02 HIGH STRENGTH BOLTS

- G. High strength bolts and associated nuts and washers shall be in accordance with ASTM F3125, grade A325 or grade A490. Bolts, nuts and washers shall meet the requirements of AISC "Specification for Structural Joints Using High Strength Bolts".
- H. Where high strength bolts are used to connect galvanized steel or are otherwise specified to be galvanized, bolts, nuts, and washers shall be hot-dip galvanized in accordance with ASTM A325.

1.02 STAINLESS STEEL BOLTS

- A. Stainless steel bolts shall conform to ASTM F-593. All underwater fasteners, fasteners in confined areas containing fluid, and fasteners in corrosive environments shall be Type 316 stainless steel. Unless otherwise specified, fasteners for aluminum and stainless steel members shall be Type 316 stainless steel.
- B. Stainless steel bolts shall have hexagonal heads with a raised letter or symbol on the bolts indicating the manufacturer, and shall be supplied with hexagonal nuts meeting the requirements of ASTM F594. Nuts shall be of the same alloy as the bolts.

1.03 CONCRETE ANCHORS

- A. General

1. Where concrete anchors are called for on the Drawings, one of the types listed below shall be used; except, where one of the types listed below is specifically called for on the Drawings, only that type shall be used. The determination of anchors equivalent to those listed below shall be on the basis of test data performed by an approved independent testing laboratory. There are two types used:
 - a. Expansion anchors shall be mechanical anchors of the wedge, sleeve, drop-in or undercut type.
 - b. Adhesive anchors shall consist of threaded rods or bolts anchored with an adhesive system into hardened concrete. Adhesive anchors shall be two part injection type using the manufacturer's static mixing nozzle and shall be supplied as an entire system.
 2. Expansion anchors shall not be used to hang items from above or in any other situation where direct tension forces are induced in anchor.
 3. Unless otherwise noted, all concrete anchors which are submerged or subject to water off-gassing, or are used in hanging items or have direct tension induced upon them, or which are subject to vibration from equipment such as pumps and generators, shall be adhesive anchors.
 4. Adhesive anchors shall conform to the requirements of ACI 355.4 or alternately to AC308. Expansion or mechanical anchors shall conform to the requirements of ACI 355.2 or alternately to AC 193.
 5. Fire Resistance: All anchors installed within fire resistant construction shall either be enclosed in a fire resistant envelope, be protected by approved fire-resistive materials, be used to resist wind and earthquake loads only, or anchor non-structural elements.
 6. Engineer's approval is required for use of concrete anchors in locations other than those shown on the Drawings.
- B. Concrete Anchor Design: An anchor design consists of specifying anchor size, quantity, spacing, edge distance and embedment to resist all applicable loads. Where an anchor design is indicated on the Drawings, it shall be considered an engineered design and anchors shall be installed to the prescribed size, spacing, embedment depth and edge distance. If all parts of an anchor design are provided on the Drawings except embedment depth, the anchors will be considered an engineered design and the Contractor shall provide the embedment depth as indicated in Paragraph B.3 unless otherwise directed by the Engineer. Where an anchor design is not indicated by the Engineer on the Drawings, the Contractor shall provide the anchor design per the requirements listed below.
1. Structural Anchors: All concrete anchors shall be considered structural anchors if they transmit load between structural elements; transmit load between non-structural components that make up a portion of the structure and structural elements; or transmit load between life-safety related attachments and structural elements. Examples of structural concrete anchors include but are not limited to column anchor bolts, anchors supporting non-structural walls, sprinkler piping support anchors, anchors supporting heavy, suspended piping or equipment,

anchors supporting barrier rails, etc. For structural anchors, the Contractor shall submit an engineered design with signed and sealed calculations performed by an Engineer currently registered in the State of Florida. Structural anchors shall be of a type recommended by the anchor manufacturer for use in cracked concrete and shall be designed by the Contractor in accordance with ACI 318 Appendix D.

2. Non-Structural Anchors: All other concrete anchors may be considered non-structural concrete anchors. The Contractor shall perform an engineered design for non-structural anchors. The Engineer may request the Contractor provide anchor design details for review, but submission of a signed, sealed design is not required. Non-structural anchors shall be designed by the contractor for use in uncracked concrete.

3. Embedment Depth

- a. Minimum anchor embedment shall be as indicated on the Drawings or determined by the Contractor's engineered design. Although all manufacturers listed are permitted, the embedment depth indicated on the Drawings is based on "SET XP by Simpson Strong-Tie". If the Contractor submits one of the other concrete adhesives anchors listed, the Engineer shall evaluate the required embedment and the Contractor shall provide the required embedment depth stipulated by the Engineer specific to the approved dowel adhesive.
- b. Where the embedment depth is not shown on the Drawings, concrete anchors shall be embedded no less than the manufacturer's standard embedment (expansion or mechanical anchors) or to provide a minimum allowable bond strength equal to the allowable yield capacity of the rod according to the manufacturer (adhesive anchors).
- c. The embedment depth shall be determined using the actual concrete compressive strength, a cracked concrete state, maximum long term temperature of 110 degrees F, and maximum short term temperature of 140 degrees F. In no case shall the embedment depth be less than the minimum or more than the maximum stated in the manufacturer's literature.

C. Structural Anchors:

1. Mechanical Anchors:

- a. Wedge Anchors: Wedge anchors shall be "Kwik Bolt TZ" by Hilti, Inc., "TruBolt +" by ITW Redhead, "Strong-Bolt 2" by Simpson Strong-Tie Co. or "Powerstud SD-1" or "Powerstud SD-2" by Powers Fasteners.
- b. Screw Anchors: Screw anchors shall be "Kwik HUS-EZ" and "KWIK HUS-EZ-I" by Hilti, Inc., "Titen HD" by Simpson Strong-Tie Co., or "Wedge-Bolt +" by Powers Fasteners. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
- c. Sleeve Anchors: Sleeve anchors shall be "HSL-3 Heavy Duty Sleeve Anchor" by Hilti, Inc. or "Power-Bolt +" by Powers Fasteners.

- d. Undercut Anchors: Undercut anchors shall be “HDA Undercut Anchor” by Hilti, Inc., “Torq-Cut Undercut Anchor” by Simpson Strong-Tie Co., “Atomic + Undercut Anchor” by Powers Fasteners.
2. Adhesive Anchors:
- a. Adhesive anchors shall be “Epcon C6+ Adhesive Anchoring System” by ITW Redhead, “HIT HY-200 Adhesive Anchoring System” by Hilti, Inc., “SET-XP Epoxy Adhesive Anchors” by Simpson Strong-Tie Co., or “Pure 110+ Epoxy Adhesive Anchor System” by Powers Fasteners.
 - b. Structural adhesive anchor systems shall be IBC compliant and capable of resisting short term wind and seismic loads (Seismic Design Categories A through F) as well as long term and short term sustained static loads in both cracked and uncracked concrete in all Seismic Design Categories. Structural adhesive anchor systems shall comply with the latest revision of ICC-ES Acceptance Criteria AC308, and shall have a valid ICC-ES report in accordance with the applicable building code. No or equal products will be considered unless prequalified and approved by the Engineer and City.
- D. Non-Structural Anchors: In addition to the acceptable non-structural anchors listed below, all structural anchors listed above may also be used as non-structural anchors.
1. Mechanical Anchors:
- a. Wedge Anchors: Wedge anchors shall be “Kwik Bolt 3” by Hilti, Inc., “Wedge-All” by Simpson Strong-Tie Co. or “TruBolt” by ITW Redhead.
 - b. Screw Anchors: Screw anchors shall be “Kwik HUS” by Hilti, Inc., “Wedge-Bolt” by Powers Fasteners “Large Diameter Tapcon (LDT) Anchor” by ITW Redhead, or “Titen HD” by Simpson Strong-Tie Co. Bits specifically provided by manufacturer of chosen system shall be used for installation of anchors.
 - c. Sleeve Anchors: Sleeve anchors shall be “HSL Heavy Duty Sleeve Anchors” by Hilti, Inc. “Power-Bolt” by Powers Fasteners “Dynabolt Sleeve Anchor” by ITW Redhead, or “Sleeve-All” by Simpson Strong-Tie Co.
 - d. Drop-In Anchors: Drop-in anchors shall be “Drop-In” by Simpson Strong-Tie Co., “HDI Drop-In Anchor” by Hilti, Inc. or “Multi-Set II Drop-In Anchor” by ITW Redhead.
 - e. Undercut Anchors: Undercut anchors shall be “HDA Undercut Anchor” by Hilti, Inc., or “Torq-Cut” by Simpson Strong-Tie Co.
2. Adhesive Anchors:
- a. Adhesive anchors shall be “Epcon A7” or “Epcon C6+ Adhesive Anchoring System” by ITW Redhead, “HIT HY-200 Adhesive Anchoring System” by Hilti, Inc., “SET Epoxy Tie High Strength Anchoring Adhesive” or “AT High Strength Anchoring Adhesive” by Simpson Strong-Tie Co., or “Powers AC 100+ Gold Vinylester Injection Adhesive Anchoring System” or “T308+ Epoxy Adhesive Injection System” by Powers Fasteners.

- b. Non-structural adhesive anchors systems shall be IBC compliant and capable of resisting short term wind and seismic (Seismic Design Categories A and B) as well as long term and short term sustained static loads in uncracked concrete.
- c. Non-structural adhesive anchor embedment depth of the rod shall provide a minimum allowable bond strength that is equal to the allowable yield capacity of the rod unless noted otherwise on the Drawings.
- d. No or equal products will be considered unless prequalified and approved by the Engineer and City.

E. Concrete Anchor Rod/Bolt Materials:

- 1. Concrete anchors used to anchor structural steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (f_y) less than 58 ksi nor an ultimate strength (f_u) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, concrete anchors shall also be galvanized unless otherwise indicated on the Drawings.
- 2. Concrete anchors used to anchor aluminum, FRP, or stainless steel shall be Type 316 stainless steel unless noted otherwise. All underwater concrete anchors shall be Type 316 stainless steel.
- 3. Nuts, washers, and other hardware shall be of a material to match the anchors.

2.03 MASONRY ANCHORS

- A. Anchors for fastening to solid or grout-filled masonry shall be adhesive anchors as specified above for concrete anchors.
- B. Anchors for fastening to hollow masonry or brick shall be adhesive anchors consisting of threaded rods or bolts anchored with an adhesive system dispensed into a screen tube inserted into the masonry. The adhesive system shall use a two-component adhesive mix and shall inject into the screen tube with a static mixing nozzle. Thoroughly clean drill holes of all debris and drill dust with nylon (not wire) brush prior to installation of adhesive and anchor. Contractor shall follow manufacturer's installation instructions. The adhesive system shall be "HIT HY-70 System" as manufactured by Hilti, Inc., or "SET-XP Epoxy-Tie" or "AT-XP Acrylic-Tie" as manufactured by Simpson Strong-Tie Co.
- C. Masonry anchors used to anchor steel shall be a threaded steel rod per manufacturer's recommendations for proposed adhesive system, but shall not have a yield strength (f_y) less than 58 ksi nor an ultimate strength (f_u) less than 72.5 ksi, unless noted otherwise. Where steel to be anchored is galvanized, masonry anchors shall also be galvanized.
- D. Masonry anchors used to anchor aluminum, FRP, or stainless steel shall be Type 304 stainless steel unless noted otherwise. All underwater anchors shall be Type 316 stainless steel.

2.04 WELDS

- A. Electrodes for welding structural steel and all ferrous steel shall comply with AWS Code, using E70 series electrodes for shielded metal arc welding (SMAW), or F7 series electrodes for submerged arc welding (SAW).
- B. Electrodes for welding aluminum shall comply with the Aluminum Association Specifications and AWS D1.2.
- C. Electrodes for welding stainless steel and other metals shall comply with AWS D1.6.

2.05 WELDED STUD CONNECTORS

- A. Welded stud connectors shall conform to the requirements of AWS D1.1 Type C.

2.06 EYEBOLTS

- A. Eyebolts shall conform to ASTM A489 unless noted otherwise.

2.07 HASTELLOY FASTENERS

- A. Hastelloy fasteners and nuts shall be constructed of Hastelloy C-276.

2.08 ANTISEIZE LUBRICANT

- A. Antiseize lubricant shall be Graphite 50 Anti-Seize by Loctite Corporation, 1000 Anti-Seize Paste by Dow Corning, 3M Lube and Anti-Seize by 3M, or equal.

PART 3 - EXECUTION

3.01 MEASUREMENTS

- A. The Contractor shall verify all dimensions and review the Drawings and shall report any discrepancies to the Engineer for clarification prior to starting fabrication.

3.02 ANCHOR INSTALLATION

- A. Anchor Rods, Concrete Anchors, and Masonry Anchors
 1. Anchor rods shall be installed in accordance with AISC "Code of Standard Practice" by setting in concrete while it is being placed and positioned by means of a rigidly held template. Overhead adhesive anchors, and base plates or elements they are anchoring, shall be shored as required and securely held in place during anchor setting to prevent movement during anchor installation. Movement of anchors during curing is prohibited.
 2. The Contractor shall verify that all concrete and masonry anchors have been installed in accordance with the manufacturer's recommendations and that the capacity of the installed anchor meets or exceeds the specified safe holding capacity.
 3. Concrete anchors shall not be used in place of anchor rods without Engineer's approval.

4. All stainless steel threads shall be coated with antiseize lubricant.

B. High Strength Bolts

1. All bolted connections for structural steel shall use high strength bolts. High strength bolts shall be installed in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". All bolted joints shall be Type N, snug-tight, bearing connections in accordance with AISC Specifications unless noted otherwise on the Drawings.
2. All stainless steel bolts shall be coated with antiseize lubricant.

C. Concrete Anchors

1. Concrete at time of anchor installation shall be a minimum age of 21 days, have a minimum compressive strength of 2500 psi, and shall be at least 50 degrees F.
2. Concrete anchors designed by the Contractor shall be classified as structural or non-structural based on the requirements indicated above.
3. Concrete Anchor Testing:
 - a. At all locations where concrete anchors meet the requirements for structural anchors at least 5 percent of all concrete anchors installed shall be proof tested to the value indicated on the Drawings, with a minimum of one tested anchor per anchor group. If no test value is indicated on the Drawings but the installed anchor meets the requirements for structural anchors, the Contractor shall notify the Engineer to allow verification of whether anchor load proof testing is required.
 - b. Contractor shall submit a plan and schedule indicating locations of anchors to be tested, load test values and proposed anchor testing procedure (including a diagram of the testing equipment proposed for use) to the Engineer for review prior to conducting any testing. Testing of anchors shall be in accordance with ASTM E488 for the static tension test. If additional tests are required, inclusion of these tests shall be as stipulated on Contract Drawings.
 - c. Where Contract Documents indicate anchorage design to be the Contractor's responsibility and the anchors are considered structural per the above criteria, the Contractor shall submit a plan and schedule indicating locations of anchors to be proof tested and load test values, sealed by a Professional Engineer currently registered in the State of Florida. The Contractor's Engineer shall also submit documentation indicating the Contractor's testing procedures have been reviewed and the proposed procedures are acceptable. Testing procedures shall be in accordance with ASTM E488.
 - d. Concrete Anchors shall have no visible indications of displacement or damage during or after the proof test. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure. Anchors exhibiting damage shall be removed and replaced. If more than 5 percent of tested anchors fail, then 100 percent of anchors shall be proof tested.

- e. Proof testing of concrete anchors shall be performed by an independent testing laboratory hired directly by the Contractor and approved by the Engineer. The Contractor shall be responsible for costs of all testing, including additional testing required due to previously failed tests.
4. All concrete anchors shall be installed in strict conformance with the manufacturer's printed installation instructions. A representative of the manufacturer shall be on site when required by the Engineer.
5. All holes shall be drilled with a carbide bit unless otherwise recommended by the manufacturer. No cored holes shall be allowed unless specifically approved by the Engineer. If coring holes is allowed by the manufacturer and approved by the Engineer, cored holes shall be roughened in accordance with manufacturer requirements. Thoroughly clean drill holes of all debris and drill dust with compressed air followed by a wire brush prior to installation of adhesive and threaded rod/bolt unless otherwise recommended by the manufacturer. Degree of hole dampness shall be in strict accordance with manufacturer recommendations. Where depth of hole exceeds the length of the static mixing nozzle, a plastic extension hose shall be used to ensure proper adhesive injection from the back of the hole. Injection of adhesive into the hole shall utilize a piston plug to minimize the formation of air pockets. Wipe rod free from oil that may be present from shipping or handling.

D. Other Bolts

1. All dissimilar metal shall be connected with appropriate fasteners and shall be insulated with a dielectric or approved equal. Unless otherwise specified, where aluminum and steel members are connected together they shall be fastened with Type 316 stainless steel bolts and insulated with micarta, nylon, rubber, or equal.

3.03 WELDING

- A. All welding shall comply with AWS Code for procedures, appearance, quality of welds, qualifications of welders and methods used in correcting welded work.
- B. Welded stud connectors shall be installed in accordance with AWS D1.1.

3.04 INSPECTION

- A. High strength bolting will be visually inspected in accordance with AISC 348 "The 2009 RCSC Specification for Structural Joints". Rejected bolts shall be either replaced or retightened as required. In cases of disputed bolt installation, the bolts in question shall be checked by a calibrated wrench certified by an independent testing laboratory. The certification shall be at the Contractor's expense.
- B. Field welds will be visually inspected in accordance with AWS Codes. Inadequate welds shall be corrected or redone as required in accordance with AWS Codes.
- C. Post installed anchors shall be inspected as required by ACI 318.

3.05 CUTTING OF EMBEDDED REBAR

- A. The Contractor shall not cut embedded rebar cast into structural concrete during installation of post-installed fasteners without prior approval of the Engineer.

END OF SECTION

SECTION 05140
STRUCTURAL ALUMINUM

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all equipment, labor, materials, and services required to provide all structural aluminum work in accordance with the Contract Documents. The term "structural aluminum" shall include items as defined in the Aluminum Association "Specifications for Aluminum Structures".

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05050 - Metal Fastening

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents. All referenced specifications, codes, and standards refer to the most current issue available at the time of the Bid.
 - 1. Florida Building Code
 - 2. Aluminum Association "Specifications for Aluminum Structures"
 - 3. AWS D1.2 - "Structural Welding Code"

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 entitled "Submittals".
 - 1. Certified Mill Test Reports
 - 2. Affidavit of Compliance with grade specified
 - 3. Shop Drawings which include the following:
 - a. Layout drawings indicating all structural shapes, sizes, and dimensions.
 - b. Beam and column schedules.
 - c. Detailed drawings indicating jointing, anchoring and connection details.
- B. Where structural design of the aluminum is not indicated on the Drawings, the Contractor shall submit design drawings of the aluminum framing, connections and anchor bolts. Such drawings shall be signed and sealed by a Professional Engineer registered in the State of Florida.

1.05 QUALITY ASSURANCE

- A. Shop inspection may be required by the City Owner¹ at his own expense. The Contractor shall give ample notice to the Engineer prior to the beginning of any fabrication work so that inspection may be provided. The Contractor shall furnish all facilities for the inspection of materials and workmanship in the shop, and the inspectors shall be allowed free access to the necessary parts of the work. Inspectors shall have the authority to reject any materials or work which do not meet the requirements of these Specifications. Inspection at the shop is intended as a means of facilitating the work and avoiding errors, but is expressly understood that it will in no way relieve the Contractor from his responsibility for furnishing proper materials or workmanship under this Specification.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Structural aluminum shall comply with Section 05010 entitled "Metal Materials".
- B. Fasteners for structural aluminum shall be in accordance with Section 05050 entitled "Metal Fastening". Fasteners shall be Type 316 stainless steel.
- C. Electrodes for welding shall be in accordance with Section 05050 entitled "Metal Fastening".

PART 3 - EXECUTION

3.01 MEASUREMENT

- A. The Contractor shall verify all dimensions and shall make any field measurements necessary and shall be fully responsible for accuracy and layout of work. The Contractor shall review the Drawings and any discrepancies shall be reported to the Engineer for clarification prior to starting fabrication.

3.02 FABRICATION

- A. Fabrication shall be in accordance with the Aluminum Association "Specifications for Aluminum Structures". Fabrication shall begin only after Shop Drawing approval.
- B. Except where otherwise noted on the Drawings or in this Specification, all shop connections shall be welded.
- C. All holes in structural aluminum members required for anchors, anchor bolts, bolt holes, or other members or for attachment of other work shall be provided by the fabricator and detailed on the Shop Drawings.
- D. All materials shall be properly worked and match-marked for field assembly.

3.03 DELIVERY, STORAGE AND HANDLING

- A. Structural members shall be loaded in such a manner that they may be transported and unloaded without being over-stressed, deformed or otherwise damaged.

- B. Structural aluminum members and packaged materials shall be protected from corrosion and deterioration. Material shall be stored in a dry area and shall not be placed in direct contact with the ground. Materials shall not be placed on the structure in a manner that might cause distortion or damage to the members or the supporting structures. The Contractor shall repair or replace damaged materials or structures as directed.

3.04 ERECTION

- A. All temporary bracing, guys and bolts as may be necessary to ensure the safety of the structure until the permanent connections have been made shall be provided by the Contractor.
- B. Structural members shall be set accurately to the lines and elevations indicated. The various members shall be aligned and adjusted to form a part of a complete frame or structure before being permanently fastened. A licensed civil engineer shall survey the structural aluminum during erection and shall provide a final survey indicating elevations and locations of all major members. Necessary adjustments to compensate for discrepancies in elevations and alignments shall be performed.
- C. No cutting of structural aluminum members in the field will be allowed except by the written approval of the Engineer.
- D. Bearing surfaces and other surfaces which will be in permanent contact shall be cleaned before assembly.
- E. Field welding shall not be permitted unless specifically indicated in the Drawings or approved in writing by the Engineer. All field welding shall comply with Section 05050 entitled "Metal Fastening".
- F. All bolted connections shall comply with Section 05050 entitled "Metal Fastening".
- G. All field connections shall be accurately fitted up before being bolted. Drifting shall be only such as will bring the parts into position and shall not be sufficient to enlarge the holes or to distort the metal. All unfair holes shall be drilled or reamed.
- H. Misfits at Bolted Connections
 1. Where misfits in erection bolting are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misfit for review by the Engineer. The Engineer will determine whether the remedy is acceptable or if the member must be refabricated.
 2. Incorrectly sized or misaligned holes in members shall not be enlarged by burning or by the use of drift pins. The Contractor shall notify the Engineer immediately and shall submit a proposed method of remedy for review by the Engineer.
 3. Where misalignment between anchor bolts and bolt holes in aluminum members are encountered, the Engineer shall be immediately notified. The Contractor shall submit a method to remedy the misalignment for review by the Engineer.
- I. Grouting of Base Plates and Bearing Plates

1. The bottom surface of the plates shall be cleaned of all foreign materials, and concrete or masonry bearing surface shall be cleaned of all foreign materials and roughened to improve bonding.
 2. Accurately set all base and bearing plates to designated levels with steel wedges or leveling plates.
 3. Baseplates shall be grouted with non-shrink epoxy grout to assure full uniform bearing. Grouting shall be done prior to placing loads on the structure. Non-shrink epoxy grout shall conform to Section 03315 entitled "Grout".
 4. Anchor bolts shall be tightened after the supported members have been positioned and plumbed and the non-shrink grout has attained its specified strength.
- J. Where finishing is required, assembly shall be completed including bolting and welding of units before start of finishing operations.
- K. All aluminum surfaces in contact with concrete shall be given a heavy coat of bituminous paint. Aluminum surfaces in contact with other metals shall be properly isolated.

3.05 FINISHES

- A. Structural aluminum shall be furnished mill finished unless noted otherwise. Anodized finish shall be furnished where noted on the Drawings.

END OF SECTION

SECTION 05500
METAL FABRICATIONS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all materials, labor, and equipment required to provide all metal fabrications not specifically included in other Sections, complete and in accordance with the requirements of the Contract Documents.
- B. Work shall include but may not be limited to lintels, guard posts (bollards), hoppers, and chutes.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05035 - Galvanizing
- B. Section 05050 - Metal Fastening
- C. Section 09900 - Painting
- D. Certain specific items are included in other Sections of the Specifications. See the section for the specific item in question.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Without limiting the generality of other requirements of these Specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section:
 - 1. Florida Building Code
 - 2. American Institute of Steel Construction (AISC) "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and "Commentary on the AISC Specification."
 - 3. American Iron and Steel Institute (AISI) "Specifications for the Design of Cold-Formed Steel Structural Members" and "Commentary on the AISI Specification."
 - 4. Occupational Safety and Health Administration (OSHA) Regulations.
 - 5. Aluminum Association "Specifications for Aluminum Structures" and "Engineering Data for Aluminum Structures."

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300, Submittals.
 - 1. Complete fabrication and erection drawings of all metalwork specified herein.

2. Other submittals as required in accordance with Section 05010, Metal Materials, and Section 05050, Metal Fastening.

PART 2 - PRODUCTS

2.01 METAL MATERIALS

- A. Materials are specified in Section 05010 entitled "Metal Materials".

2.02 METAL FASTENING

- A. All welds and fasteners used in metal fabrication shall conform to Section 05050, Metal Fastening, unless noted otherwise.

2.03 LINTELS

- A. Where metal lintels are shown on the Drawings, provide lintels as specified herein with 8 inches minimum bearing each side unless noted otherwise.
- B. All metal lintels shall be steel in accordance with Section 05120, Structural Steel, and shall be galvanized in accordance with Section 05035, Galvanizing, unless noted otherwise.

2.04 GUARD POSTS (BOLLARDS)

- A. Guard posts shall be as detailed on the Drawings, including plastic covers, pipe sleeves, concrete fill, crushed fill and grouting to secure parts. If not indicated on the Drawings, guard posts shall be minimum 6-inch diameter steel pipe. Pipe for guards shall be galvanized steel, Schedule 40 pipe that conforms to ASTM A53. Painting shall be in accordance with Section 09900 entitled "Painting".
- B. Guard posts shall be concrete filled and crowned, as detailed on the Drawings.

PART 3 - EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.
- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.

- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to Section 05050, Metal Fastening. All fastenings shall be concealed where practicable.
- G. Fabricated items shall be shop painted when specified in Section 09900, Painting.

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All miscellaneous metalwork shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.
- C. Metal work shall be field painted when as specified in accordance with Section 09900, Painting.

END OF SECTION

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SECTION 05515

LADDERS

PART 1 - GENERAL

1.01 REQUIREMENT

- A. The Contractor shall furnish all materials, labor, and equipment required to provide all ladders in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05500 – Metal Fabrications
- C. Section 05520 – Handrails and Railings

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of the Specifications, all work specified herein shall conform to the applicable requirements of the following documents.
 - 1. Florida Building Code (FBC)
 - 2. Aluminum Association Specifications for Aluminum Structures
 - 3. Occupational Safety and Health Administration (OSHA) Regulations

1.04 SUBMITTALS

- A. Submit the following in accordance with Section 01300 entitled "Submittals".
 - 1. Complete fabrication and erection drawings of all metalwork specified herein.
 - 2. Other submittals as required in accordance with Section 05500 entitled "Metal Fabrications".

PART 2 - PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials, fasteners and welds used for ladders shall conform to Section 05010 entitled "Metal Materials", unless noted otherwise.

2.02 VERTICAL LADDERS

- A. Ladders shall be furnished with all mounting brackets, baseplates, fasteners, and necessary appurtenances for a complete and rigid installation.
- B. All ladders shall be aluminum alloy 6061-T6 or 6063-T5 with a clear, anodized finish, Aluminum Association M12C22A41, unless noted otherwise.

- C. All ladders shall conform to dimensions indicated on the Drawings and shall comply with OSHA requirements.
- D. Side rails shall be 2-1/2 inch x 3/8 inch runners.
- E. Rungs shall be solid serrated 3/4-inch diameter, minimum.
- F. All exposed connections shall be welded and ground smooth.
- G. All fixed ladders terminating below a roof, floor or wall shall be provided with Bilco Model 2 Ladder Up Safety Posts, or equal. The safety post system components shall be suitable for service in a corrosive environment. The safety posts shall be manufactured of high strength, hot dip galvanized steel with telescoping tubular sections that lock automatically when fully extended. Upward and downward movement shall be controlled by a stainless steel spring balancing mechanism. The safety posts shall be completely assembled with fasteners for securing to the ladder rungs in accordance with the manufacturer's recommendations.

2.03 SAFETY CAGE

- A. For ladders exceeding twenty four feet in height, provide a safety cage in accordance with OSHA requirements.
- B. Safety cages shall be fabricated of 1/4-inch aluminum plates designed to meet OSHA requirements.
- C. An operable access door with padlock shall be provided for all safety cages.

2.04 FALL PREVENTION SYSTEM

- A. Ladders with an uninterrupted length exceeding 24 ft shall be installed with a fall prevention system, unless indicated otherwise on the drawings.
- B. Fall prevention system shall comply with OSHA requirements.
- C. Fall prevention system shall include all necessary components to provide a fully operational system, including one full body safety harness with a 310 lb. weight capacity for each fall prevention system. System shall have a fall locking device, impact attenuator, and rail system. Rail extension with dismounting system, which allows detachment from the system while not standing on the ladder, shall be provided for ladders accessed thru hatch openings. All components shall be stainless steel with a non-metallic cable guide.
- D. Fall Prevention Systems shall be RTC 2000 Climb-Rite System, Sellstrom Manufacturing Company, or Saf-T-Climb Fall Prevention System, Norton by Honeywell.

PART 3 - EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work.

- B. All fabricated work shall be shop fitted together as much as practicable, and delivered to the field, complete and ready for erection.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and shall be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. All fastenings shall be concealed where practicable.
- G. Fabricated items shall be shop painted when specified in accordance with Section 09900 entitled "Painting".

3.02 INSTALLATION

- A. Assembly and installation of fabricated system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All ladders shall be erected square, plumb and true, accurately fitted, adequately anchored in place, and set at proper elevations and positions.
- C. Metalwork shall be field painted when specified in accordance with Section 09900 entitled "Painting".

END OF SECTION

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SECTION 05520

HANDRAILS AND RAILINGS

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, fabricate, and install handrails and railings and appurtenances, complete, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 - Metal Materials
- B. Section 05500 - Metal Fabrications
- C. Section 05510 - Metal Stairs

1.03 SUBMITTALS

- A. Shop drawings of all handrails and railings shall be submitted to the Engineer for review in accordance with Section 01300 entitled "Submittals."
- B. Calculations for handrailing signed/sealed by Engineer to be submitted.

PART 2 - PRODUCTS

2.01 ALUMINUM RAILING SYSTEM

- A. General: Where indicated on the Drawings, pipe handrailing shall be provided. Pipe handrailing shall be supplied as required by the Florida Building Code and OSHA whether indicated on the Drawings or not.
- B. Vertical pipe supports shall include cast aluminum base flange or side mount bracket with set screws as indicated on Drawings. Removable posts shall be sleeved. Cast aluminum base flanges and side mount brackets shall be as manufactured by Thompson Fabricating Inc., Hollaender Manufacturing Inc., or equal.
- C. Wall brackets for handrail shall be of designs indicated on the Drawings and shall be as manufactured by Mouitrie Manufacturing Company, J.G. Braun Company, Fulton Metal Products Company, or equal.
- D. All connections between vertical posts and horizontal railing or between sections of horizontal railings shall be shop welded continuous in as long of sections as practical. Tack welds shall not be accepted. All welds shall be water tight and ground smooth. Field assembly of welded sections may be made by mechanical fasteners. Location and type of field connections shall be subject to the Engineer's review. Weep holes shall be shop drilled in all vertical posts of external railing.

- E. Design Load: All components of the railings and the railing system shall be adequately designed to resist the design loads of the Florida Building Code. In no case shall the spacing of vertical pipe supports exceed five feet.
- F. Aluminum Railing: Railing Posts shall be nominal 2 inch nominal diameter, Schedule 80 (minimum) aluminum alloy 6061 T6. Horizontal railing shall be 1-1/2 inch nominal diameter, Schedule 40 (minimum) aluminum pipe sections. Stainless steel railing may be used in lieu of aluminum railing at the Contractor's option at no additional cost to the City.
- G. Kickplates: Kickplates shall be furnished and installed typically at the edges of all walkways and at other handrail installations. Kickplates shall be an extrusion that attaches to the posts with clamps that will allow for expansion and contraction between posts, must meet OSHA requirements, shall project 4 inches above walkway surface, shall be set 1/4-inch above the walking surface, may not infringe on minimum required walkway width and must be of the same material as that of the handrail construction.
- H. Expansion joint splices shall be provided at 30 feet maximum spacing and at all expansion joints in the structure supporting the handrail. Material for the expansion joint shall be the same as railing material.
- I. Finish: Aluminum railings and posts shall be provided with a clear anodized finish (215 R1).

2.02 FASTENERS

- A. Fasteners when required or specified shall be Type 316 stainless steel.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

3.02 PREPARATION

- A. Clean and strip primed items to bare metals where site welding is required.
- B. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors and plates required for connecting railings to structure.
- C. Aluminum Railings: Aluminum railing fabrication shall be performed by craftsmen experienced in the fabrication of architectural metal work. Exposed surfaces shall be free from defects or other surface blemishes. Dimensions and conditions shall be verified in the field. All joints, junctions, miters and butting sections shall be precision

fitted with no gaps occurring between sections, and with all surfaces flush and aligned. Electrolysis protection of materials shall be provided. All dissimilar materials shall be isolated.

3.04 EXPANSION BOLTS

- A. Expansion bolts shall be spaced 10d apart and 6d edge distance (d=diameter of bolt). A safety factor of four shall be provided on expansion bolt pull out values published by the manufacturer.

3.05 ALUMINUM SURFACES

- A. Aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of bitumastic or other approved materials.

END OF SECTION

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SECTION 05531

GRATING, FLOOR PLATES AND ACCESS HATCHES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish, fabricate, and install gratings, floor plates, access hatches and appurtenances, complete, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 05010 – Metal Materials
- B. Section 05035 - Galvanizing
- C. Section 05050 – Metal Fastening
- D. Painting and protective coating of metalwork and fabricated items shall, unless otherwise specified herein, be performed in accordance with the requirements of the Section entitled "Painting."

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Specifications, codes and standards shall be as specified in Section 05010 entitled "Metal Materials" and as referred to herein.

1.04 SUBMITTALS

- A. Submit the following in accordance with the Section entitled "Submittals":
 - 1. Complete fabrication and erection drawings of all gratings, floor plates, access hatches and access doors specified herein.
 - 2. Other submittals as required in accordance with the Section entitled "Metal Fabrications."

PART 2 - PRODUCTS

2.01 METAL MATERIALS

- A. Metal materials used for gratings, floor plates and hatches shall conform to Section 05010 entitled "Metal Materials," unless noted otherwise.

2.02 METAL FASTENING

- A. All welds and fasteners used for gratings, floor plates and hatches shall conform to Section 05050 entitled "Metal Fastening," unless noted otherwise.

2.03 GRATING

- A. General: Grating, including support frames, fastenings, and all necessary appurtenances for a complete installation shall be furnished as indicated on the Drawings and specified herein.
1. All exposed bearing ends of grating shall be enclosed in a perimeter band of the same dimensions and materials as the main bars, including ends at all cutouts.
 2. Grating shall be fabricated into easily removable sections and shall be fastened at each corner and as required with fasteners provided by the grating manufacturer. No section of grating shall weigh in excess of 50 lbs. unless noted otherwise. No fasteners shall be permitted to project above the walking surface.
 3. Gratings shall be designed for a loading of 150 psf unless a depth is required by the Drawings. When grating depth is not indicated on the drawings, minimum grating depth shall be 1 ½-inches and deflection shall not exceed L/240 or ¼-inch.
 4. All grating shall be furnished with holddowns.
 5. Grating installed in cast-in-place concrete shall be provided with embedded support frames on all perimeter and bearing edges. Support frames shall include anchor straps or headed studs at a maximum of 18-inches on-center, a minimum of two each side. Support frames shall be fabricated from the same material as the grating.
- B. Aluminum Grating
1. Aluminum grating shall be of I-Bar type and shall consist of extruded bearing bars positioned and locked by crossbars. All supports, cross members, etc. shall be aluminum. Plank clips for grating hold downs or other required attachments shall be aluminum or stainless steel. Bolts shall be stainless steel. Provide embedded aluminum support frames for cast-in-place concrete installations.
 2. Grating shall be "19-SI-4 I-Bar Swage Locked" by Alabama Metal Industries Corporation (AMICO), "IB" by Harsco Industrial IKG, "I-Bar 19SGI4", by Ohio Grating Inc., or "I-Bar" by Thompson Fabricating LLC.
 3. Grating shall be provided with a mill finish.
- C. Aluminum Plank Grating
1. Aluminum plank grating shall be un-punched, 6-inch wide extruded section panels, heavy duty type with 6 ribs and plain sides, welded together to form panels. Panel ends shall have an extruded aluminum end bar welded in place. All support members shall be aluminum. Plank clips for grating holddowns or other required attachments, shall be aluminum or stainless steel. Bolts shall be stainless steel. All planks shall be provided with embedded aluminum support frame for cast-in-place concrete.
 2. Removable sections shall be edge banded in sections and provided with stainless steel flush mounted lift handles with necessary plank reinforcing and hold down anchors.

3. Hinged sections shall be shop fabricated ready for field installation. Panels shall be edge banded with a continuous hinge, flush mounted lifting handles (1 section minimum), stainless steel bolts and hardware. Grating frame shall be provided with removable temporary braces to maintain the required opening width during casting. Provide necessary grating reinforcing for lift handles, hinge connections, hold down anchors, etc.
4. Plank grating shall be provided with a mill finish.
5. Aluminum plank grating shall be HD-P manufactured by Harsco Industrial IKG., Heavy Duty Series manufactured by Ohio Gratings, Inc., or Unpunched Duo-Grip Extruded Series manufactured by Alabama Metal Industries Corporation (AMICO).

D. Steel Grating

1. Steel grating shall be custom welded heavy duty steel grating per ANSI/NAMM MBG 532-000. Minimum bearing bar size shall be 2¼-inch by ¼-inch. All supports, cross members, etc. shall be galvanized steel. Plank clips for grating hold downs shall be stainless steel. Bolts shall be galvanized steel.
2. All openings shall be banded.
3. Steel grating shall be galvanized according to the Section entitled "Galvanizing."
4. Main bearing bars shall conform to ASTM A36. Cross bars shall be flush with the top of the grating.
5. Grating span shall be 36 inches maximum and shall satisfy AASHTO loading for H-20 truck.
6. Grating shall be manufactured by IKG Borden Industries, Leeds, AL or equal.

2.04 CHECKERED PLATES

- A. Checkered plates shall be aluminum alloy 6061-T6, or galvanized steel as indicated on the Drawings. Aluminum checkered plates shall be provided in mill finish, except when otherwise indicated on the Drawings. Checkered plates shall be designed for a live load of 150 pounds per square foot of the gross projected area. The allowable deflection under the above loadings shall be L/240 but not more than ¼-inch. Minimum thickness shall be 3/8-inch, unless otherwise noted on the Drawings.
- B. Checkered plates shall be standard pattern non-slip of the thickness and sizes on the Drawings. Stiffener angles shall be provided as required to meet the load requirements specified above. All checkered plate sections shall be cut that no one section shall weigh more than 100 pounds.
- C. Flush type lifting handles and hinges and neoprene seals for airtight construction shall be provided where shown on the Drawings.
- D. At locations noted, neoprene gaskets shall be provided between floor plates and frames. Plates shall be screwed into frames when noted on the Drawings.
- E. Hinges, where indicated on the Drawings, shall be heavy-duty, cadmium plated bronze with stainless steel pins and fasteners.

- F. Removable Sections: Plates shall be fabricated in removable sections with weight not exceeding 60 pounds each with flush mounted handles and removable hold down stainless steel bolts.

2.05 ACCESS HATCHES

A. General

1. Door opening sizes, number and direction of swing of door leaves, and locations shall be as shown on the Drawings. The Drawings show the clear opening requirements. Door leaves shall be 1/4 inch, minimum, diamond pattern plate with an approved raised pattern, non-skid surface. Plate shall be stiffened as required to maintain allowable stress and deflection requirements. Stiffeners shall consist of angles or bars welded to the bottom of plate.
2. All doors shall be aluminum (mill finish) unless otherwise noted. All doors in locations subject to direct vehicular traffic shall be galvanized steel designed for H-20 live loads.
3. Openings larger than 42 inches in either direction shall have double leaf doors.
4. Doors shall be designed for flush mounting and for easy opening from both inside and outside.
5. All doors shall be provided with an automatic hold-open arm with release handle.
6. Double leaf doors shall be provided with Type 316 stainless steel safety chains to go across the open sides of the door, when in the open position. Brackets shall be provided on the underside of the doors to hold the safety bars when not in use.
7. All hardware, including but not limited to, all parts of the latch and lifting mechanism assemblies, hold open arms and guides, brackets, hinges, springs, pins, and fasteners shall be Type 316 stainless steel.
8. All doors shall be watertight with a continuous gasket. All single door applications shall include a continuous EPDM odor reduction gasket.
9. Cylinder locks with keyway protected by a cover plug shall be provided with all hatches.
10. Door leafs shall be 1/4-inch aluminum diamond plate, minimum, stiffened and designed for H-20 live loads at areas that could receive traffic wheel loads.
11. Door frames shall be trough-type or angle-type as indicated on the Drawings and equipped with a built-in neoprene cushion. On trough-type frames, the drainpipe shall be provided by the Contractor and shall extend to the nearest point of discharge acceptable to the Engineer.
12. Exterior doors shall be Type "J-AL" or "JD-AL", by Bilco Company, Type "W1S" or "W2S" by Halliday Products Inc., Type "TPS" or "TPD", by U.S.F. Fabrication Inc., Type "THG" or "THG-D", by Thompson Fabricating LLC., or equal.

13. Interior doors shall be Type "K" or "KD", by Bilco Company, Type "S1S" or "S2S" by Halliday Products Inc., Type "APS300" or "APD300", by U.S.F. Fabrication Inc., Type "TH" or "TH-D", by Thompson Fabricating LLC., or equal.
14. Doors rated for H-20 traffic loading shall be "JAL-HD" or "JDAL-HD" by the Bilco Company, Type "H1W" or "H2W" by Halliday Products, Inc.
15. Hatches shall be guaranteed against defects for a period of five years.

B. Roof Access Hatches

1. Roof access hatches shall be designed for a 50 psf live load minimum, unless noted otherwise.
2. Roof access hatches for service stairs shall be Bilco Type L Roof Scuttles.
3. Roof access hatches for ladder access shall be Bilco Type S or SS Roof Scuttles.

C. Equipment Access Hatches

1. Equipment access hatches shall be Bilco Type D or equal. Equipment access hatches shall be provided with curb and integral cap flashing.

2.06 FIXED LADDERS

- A. Where the Contract Documents indicate fixed ladders are required under access hatches, they shall be provided with "LadderUp, Model LU-4" by Bilco Company, "L1E Ladder Extension" by Halliday Products Inc., or "Ladder Climb-out Device" by Thompson Fabricating.
- B. The safety posts shall be manufactured of the same material as the access door with telescoping tubular sections that lock automatically when fully extended.
- C. Upward and downward movement shall be controlled by a stainless steel balancing mechanism.
- D. Safety posts shall be assembled in strict accordance with manufacturer's recommendations.

2.07 FALL THROUGH PREVENTION SYSTEM

- A. All access hatches and access doors covering openings measuring 12 inches or more in its least dimension through which persons may fall shall be equipped with a fall through prevention system, except where noted on the Contract Drawings. Access hatches and access doors shall be provided with a permanent installed fall through prevention grate system that provides continuous safety assurance in both its closed and open positions. The grate system shall be made with 6061-T6 aluminum or FRP and be designed for a 300 psf minimum live load, unless noted otherwise.

PART 3 - EXECUTION

3.01 FABRICATION

- A. All measurements and dimensions shall be based on field conditions and shall be verified by the Contractor prior to fabrication. Such verification shall include coordination with adjoining work. Fabrication shall begin only after such field measurements.
- B. All fabricated work shall be shop fitted together as much as practicable and delivered to the field, complete and ready for erection, unless sections have to be removable. All miscellaneous items such as stiffeners, fillets, connections, brackets, and other details necessary for a complete installation shall be provided.
- C. All work shall be fabricated and installed in a manner that will provide for expansion and contraction, prevent shearing of bolts, screws, and other fastenings, ensure rigidity, and provide a close fit of sections.
- D. Finished members shall conform to the lines, angles, and curves shown on the Drawings and be free from distortions of any kind.
- E. All shearings shall be neat and accurate, with parts exposed to view neatly finished. Flame cutting is allowed only when performed utilizing a machine.
- F. All shop connections shall be welded unless otherwise indicated on the Drawings or specified herein. Bolts and welds shall conform to the Section entitled "Metal Fastening." All fastenings shall be concealed where practicable.

3.02 INSTALLATION

- A. Assembly and installation of fabricate system components shall be performed in strict accordance with manufacturer's recommendations.
- B. All gratings, access hatches, and access doors shall be erected square, plumb and true, accurately fitted, adequately anchored in place and set at proper elevations and positions.

END OF SECTION

SECTION 05800
EXPANSION JOINT COVERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Expansion joint cover assemblies.
2. Fire barriers.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 05010 – Metal Materials
4. Section 07541 - PVC Membrane Roofing - Fully Adhered.
5. Section 07600 - Flashing and Sheet Metal.
6. Section 07920 – Sealants and Caulking.
7. Section 09310 - Ceramic Tile.
8. Section 09961 - Painting and High Performance Industrial Coatings.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. The Aluminum Association (AA):
 - a. DAF 45, Designation System for Aluminum Finishes.
2. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - c. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - d. D2000, Standard Classification System for Rubber Products in Automotive Applications.

- e. E1399, Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
- 3. Underwriters Laboratories, Inc. (UL):
 - a. 2079, Standard for Tests for Fire Resistance of Building Joint Systems.
 - b. Building Materials Directory.

1.03 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- B. Heavy Duty: Capable of withstanding a point load of 2000 LB without damage or permanent deformation.
- C. Standard Duty: Capable of withstanding a point load of 500 LB without damage or permanent deformation.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Scaled plan and detail Drawings.
 - a. Drawings shall show expansion joint cover locations, types, extents, joints, controlling dimensions, details, etc.
 - b. Minimum plan scale: 1/8 IN = 1 FT 0 IN.
 - c. Minimum detail scale: 3/4 IN = 1 FT 0 IN.
- B. Samples:
 - 1. Minimum 12 IN long sample of each type of expansion joint assembly and cover specified.
 - a. Actual color samples of resilient inserts for Engineer's selection.
- C. Informational Submittals:

1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.
2. Certifications:
 - a. UL Certification of fire rated assemblies

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Expansion joint covers:
 - a. C/S Group.
 - b. MM Systems.
 2. Expansion joint fire barrier:
 - a. C/S Group.
 - b. MM Systems.
- B. Submit request for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

- A. Aluminum:
 1. Sheet and plate: ASTM B209, alloy 6061-T6.
 2. Extrusions, bars, rods, wire, and tubes: ASTM B221, alloy 6063-T5.
- B. PVC: ASTM D1784.
- C. Thermoplastic Elastomer:
 1. Extrusions and sheet goods: ASTM D2000.

2.03 MANUFACTURED UNITS

- A. General:
 1. Product numbers listed are based on MM Systems.
 2. Provide expansion joint cover assemblies of design, profile, materials and operation indicated.
 - a. Factory fabricated joints, transitions, connections and intersections.
 3. Provide manufacturer's standard anchors, fasteners, spacers, vapor seals, filler materials, adhesive and other accessories as required for complete installation.

4. Where expansion joint covers are located in fire-rated assemblies, include fire-barrier system to provide a UL listed joint assembly.
 5. Provide units in longest practicable lengths to minimize number of end joints.
 - a. Locate end joints in non-conspicuous areas; avoid locating in traffic areas.
 6. Finishes:
 - a. Aluminum: Clear anodized AA-M12C22A41.
 - b. Elastomeric inserts: To be selected by Engineer.
- B. Floor Expansion Joint Covers:
1. Continuous extruded aluminum frame assemblies with floating cover plate and seal.
 - a. Provide continuous neoprene waterstop at floor-ceiling assemblies.
 2. Standard duty, block-out mount:
 - a. Concrete and ceramic tile floors:
 - 1) Floor-to-floor joints: Series HFX.
 - 2) Floor-to-wall joints: Series HFXE.
 3. Heavy duty, block-out mount:
 - a. Floor-to-floor joints: Series EHFEX.
 4. Provide standard duty covers in administrative areas.
 - a. Provide heavy duty covers in all process related areas and areas not considered as administrative or office areas.
 5. Refer to Drawings for joint width.
- C. Wall Expansion Joint Covers:
1. Gypsum board wall assemblies:
 - a. Frame: Aluminum with square corners designed for overlay construction on finished face of gypsum board.
 - b. Wall to wall: Series X-M.
 - c. Corner wall: Series X-N.
 2. Precast concrete, cast-in-place concrete or masonry wall assemblies:
 - a. Frame: Extruded aluminum designed for recessed construction in joint.
 - b. Continuous elastomeric inserts:

- 1) Primary seal:
 - a) Extruded thermoplastic elastomer.
 - b) Color to be selected by Engineer.
 - 2) Secondary seal: PVC.
 - c. Wall to wall joints: Series VSS.
 - d. Wall to wall at corner joints: Series VSS.
- D. Floor Expansion Joint Covers:
1. Concrete floors with no additional topical finishes applied:
 - a. Floor to floor: Series LMS.
 - b. Floor to wall: Series LMS-C.
- E. Fire Barriers:
1. Flexible mat material with corrugated metal facing on each face and continuous galvanized steel mounting angles.
 2. Designed for required dynamic structural movement without material degradation or fatigue in accordance with ASTM E1399.
 3. Prefabricated for hourly rating of adjacent floor, wall or ceiling assemblies.
 - a. UL labeled: Tested in maximum joint width condition as a component of a joint assembly in accordance with UL 2079.

2.04 ACCESSORIES

- A. Fire-rated Sealant: See Specification Section 07920.
- B. Fasteners:
 1. Stainless steel.
 2. See Specification Section 05010.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Provide items to be built into other construction to Contractor in time to allow their installation.
 1. If such items are not provided in time for installation, coordinate block-out requirements for later installation.
 2. Where block-outs are subject to traffic or potential for damage, provide temporary fillers to protect joint until specified items can be installed.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
 - 1. Locate end joints in non-conspicuous areas; avoid locating in traffic areas.
 - 2. Seal joints in accordance with manufacturer's written installation instructions.
 - 3. Ensure bolting joints are fastened such that the two (2) components create a smooth flat surface with hairline jointery unless a wider joint is required by the joint cover manufacturer.
- B. Set work level, true and plumb.
- C. Install fire barriers in fire-rated sealant as required for UL assembly required.
- D. Provide dissimilar materials protection in accordance with Specification Section 09961.
- E. After installation, clean all aluminum surfaces to remove excess sealant, adhesives, etc.
 - 1. Repair or replace damaged inserts, patch paint coatings on components having scratched or otherwise damaged finish coatings.
 - 2. Replace all components that cannot be adequately repaired to satisfaction of the Engineer and the Owner.

END OF SECTION

SECTION 06100
ROUGH CARPENTRY

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Furnish labor, materials, equipment and appliances required for complete execution of Work shown on the Drawings and specified herein.
- B. Principal items of work include:
 - 1. Wood blocking, nailers, grounds, furring, ties, centering, etc., necessary or required for attachment or support of work under this Section, and other Sections.
 - 2. Fasteners, including nails, screws, bolts, anchors and other fastenings, required to secure work under this Section.
 - 3. Temporary enclosures and protective boarding.
 - 4. Wood preservative treatment for all wood members in contact with roofing, masonry, concrete, and exposed to the elements.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of these specifications Work shall conform to the applicable requirements of the following documents:
 - 1. AWPA CA Preservative Standards, Lumber and Plywood.
 - 2. AWPA C20 Structural Lumber Fire-Retardant Treatment by Pressure Process.
 - 3. AWPC C27 Plywood Fire-Retardant Treatment by Pressure Process.
 - 4. AWPA M4 Standards for Care of Preservative Treated Wood Products.
 - 5. APAG Guide to Plywood Grades.
 - 6. FM 1-49 Perimeter Flashing

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in Section 01300 - Submittals, submit the following:
 - 1. Certifications of Preservative and Fire Retardant Treatment.
 - 2. Warranty of treatment manufacturer.
 - 3. Certification of type and grade of lumber to be used.
 - 4. Certification of type, rating and conformance to APA Standards.

1.04 DELIVERY AND STORAGE

- A. Take all measures necessary to protect products against damage during delivery and storage.
- B. Store lumber in enclosed places in such a manner to provide ventilation and protection from the weather.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Blocking, nailers, grounds and the like: Eastern Spruce or Douglas Fir No. 3 Dimension Lumber or Construction Grade, with a moisture content not to exceed 19%.
- B. Plates, blocking, and nailers in contact with concrete or masonry: Pressure treated southern yellow pine.
- C. Plywood: Identified with APA Grade trademarks of the American Plywood Association, in thickness as shown on the Drawings.
 - 1. Exterior: AC EXT APA where exposed to view or a finish is required, CD-EXT-APA where concealed.
 - 2. Interior: AC INT APA where exposed to view or a finish is required, CD-INT-APA where concealed.
- D. Structural Framing Lumber: Douglas Fir No.1 grade with fb = 1,500 pounds per square inch and E = 1,700,000 pounds per square inch, 19 percent moisture content.
- E. Fasteners: Provide clamps, connectors, straps, nails, bolts, screws, anchors, ties and other accessories and fasteners shown or required to properly secure all rough carpentry. Fasteners and accessories shall be stainless steel, galvanized, or other noncorrosive metal recommended for use. Fasteners used with pressure treated wood shall be compatible with the wood preservative treatment to prevent corrosion of fasteners.
- F. Wood Preservative Treatment: Waterborne pressure treatment in conformance with the American Wood Preservers' Association standard P5. Retention shall be in accordance with AWWPA Standards and be a minimum of 0.40 pounds per cubic foot for contact with or below ground, concrete, or masonry and 0.25 pounds per cubic foot for above ground. Stamp each piece of treated wood with a trademark identifying the classification of the treatment or a certificate from the processor for each shipment.
- G. Fire Retardant Treatment: Fire-retardant lumber and plywood must have an Underwriters Laboratories stamp signifying a FR-S rating and certifying a 25 or less flame spread and smoke developed value, when tested in accordance to UL 723, ASTM E 84, and NFPA 255 "Tunnel Test", and when the test is extended for 20 additional minutes. Treatment formulation shall contain no halogens, sulfates, chlorides or ammonium phosphate. Smoke toxicity shall be no more than that of untreated wood.

H. Connecting Hardware

1. Nails shall be stainless steel common wire for exterior work.
2. Screws shall be standard domestic manufacture, stainless steel for exterior use and of brass, bronze, aluminum or stainless steel when used to attach items made of those materials.
3. Bolts shall be machine bolts (or carriage bolts if called for on Drawings) of Series 300 stainless steel with hexagon nuts, of sizes noted on Drawings. Wood fascia fasteners shall be galvanized steel and conform to the requirements of ASTM Designation A 307.
4. Steel plates and angles shall be carbon steel, ASTM A 36, galvanized after fabrication for temporary items and stainless steel for permanent items as shown on the Drawings.
5. Lag screws, shear plates and split ring connectors shall conform to the requirements of the "National Design Specifications for Wood Construction from the National Forest Products Association and shall be stainless steel.
6. Power actuated fasteners shall conform to Federal Specification GGG-D-777a, and shall be installed as per manufacturer's printed directions. Power charge shall be powerful enough to prevent spalling of concrete.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate with all trades as to nailers, blocking, grounds and the like required for the attachment of their work and other items requiring same. Carry out all work as required to cooperate work of other trades.

3.02 INSTALLATION

- A. Perform work in conformance manufacturer's recommendations and specifications, industry, national and local standards and codes.
- B. Layout, cut, fit and erect rough blocking, nailers, furring and other rough carpentry. Do cutting work in connection with carpentry and finish for other trades. Brace plumb and level all members in true alignment and rigidly secure in place with sufficient nails, spikes, screws and bolts. Defects which render any piece or part unable to serve its intended purpose shall be discarded or, cut out and replaced.
- C. Provide all bracing, supports and shoring required to support construction.
- D. Protect all masonry including edges of concrete platforms and similar items. Remove protective covering when directed. Take special precautions at masonry openings and corners of the building.
- E. Set all rough hardware, such as plates, spikes, bolts, nails, lag screws, lagging bolts, anchors, etc., as required to hold woodwork together or to anchor or secure it to other materials and construction.

- F. Provide wood grounds, nailing strips and similar items wherever necessary or required throughout the project for the support, proper erection or installation of the work and support of mirrors, cabinets, shelf cleats, base and similar items. Thoroughly secure in place by approved means.
- G. Secure wood grounds, nailing strips and similar items to metal plugs set in masonry, toggle or expansion bolts. Give the mason all necessary information to enable him to lay out correctly the location for metal wall plugs. Wood plugs will not be accepted.
- H. Construct joints to support dead loads, live loads, snow loads, wind loads, or combinations in conformance with "National Design Specifications for Stress Grade Lumber and its Fastenings", recommended by National Forest Products Association.
- I. Nailers and Blocking: Provide and secure wood nailers, blocking, for the reception of roof curbs, roofing, etc. in accordance with FM I-49, or as required by the Building Code, whichever is most stringent. Coordinate attachment with roofing system, where roofing system design includes design of nailers provide attachment in accordance with engineered roofing design.
 - 1. Provide nailers of sizes, shapes and profiles indicated on the Drawings. Nailers shall not be less than 2 x6. Build up nailers as required to achieve thickness of insulation or as required to provide proper attachment of roofing and curbs. Provide anchors as required for secure attachment of roofing systems, copings, gravel stops or other edge terminations.

3.03 TEMPORARY PROTECTION

- A. Provide and install all temporary protection in accordance with applicable provisions of the Contract Documents, OSHA regulations, and as follows:
 - 1. Temporary protection shall include wood doors, railings, protection of floor or roof openings, temporary partitions, and the like; adequately maintained in good repair during the life of the Contract.
 - 2. Furnish and set temporary partitions with wood doors at all exterior doorways, exterior openings or in locations exposed to weather. Substantially build and hang, with proper hinges, locks and other necessary hardware, and remove and reset whenever required to accommodate the Work and keep in good repair.
 - 3. Provide substantial temporary wood covering or guards for openings left in floor or roof slabs for ducts, shafts, etc., using rough planking at least 2 inch thick, cleated together and otherwise made sufficiently strong and put in place wherever required immediately after the forms have been removed.

3.04 JOB CONDITIONS

- A. If the installation of metal frames and glass does not promptly follow the completion of the exterior enclosures, and if the absence of enclosures would cause damage, close in all such openings temporarily by the use of heavy polyethylene plastic sheeting, or canvas stretched over and nailed to frames of 1 inch x 2 inch or heavier strips.

3.05 REMOVAL OF TEMPORARY WORK

- A. Remove all temporary protection when so directed, or prior to acceptance of this project.

END OF SECTION

SECTION 06400

WOOD FRAMING AND SHEATHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Wood Framing and Sheathing, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.02 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Minimum five years of experience in wood frame construction similar in material, design, and extent indicated on Drawings.
- B. Local Building Code shall govern when conflicts occur.
- C. Dimension Lumber: US Product Standard PS20-10 American Softwood Lumber Standard.
- D. Plywood Sheathing: US Product Standard PS1-07 Structural Plywood.
 - 1. Oriented Strandboard Sheathing: US Product Standard PS2-04 Performance Standard for Wood Based Structural Use Panels.
 - 2. AWC National Design Specification for Wood Construction and Supplement ANSI/AWC NDS.
- E. Obtain engineered wood products from one source and by a single manufacturer.
- F. Obtain each type of fire retardant treated wood product from one source and by a single producer.

1.03 SUBMITTALS

- A. Product Data:
 - 1. Engineered wood products.
 - 2. Metal framing anchors.
 - 3. Construction adhesives.
 - 4. Wood treatment data:
 - a. Chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated materials.

- b. For each type of preservative treated wood product, include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained and compliance with applicable standards.
 - c. For waterborne treated products, include statement that moisture content of treated materials were reduced to levels indicated before shipment to project site.
 - d. For fire retardant treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness, and fastener holding capacities of treated materials.
5. Material test reports from a qualified independent testing agency indicating and interpreting test results relative to compliance of fire-retardant-treated wood products with requirements indicated.
6. Research or evaluation reports acceptable to authorities having jurisdiction that evidence following products compliance with building code:
- a. Engineered wood products.
 - b. Metal framing anchors.
 - c. Power driven fasteners.
 - d. Fire-retardant treated wood.
- B. Project Information:
1. Proof that framing installer has a minimum of five years of experience, including a list of last four wood framed buildings completed by installer.
 2. Certification of fire retardant treated material.
 3. Certification of preservative treated material.
- C. Contract Closeout Information:
1. Certificate by framing installer that wood frame was constructed in accordance with project plans and specifications.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Engineered Wood Products:
1. Base:
 - a. Boise Cascade
 2. Optional:

- a. Georgia Pacific
- b. Louisiana-Pacific
- c. RedBuilt
- d. Weyerhaeuser

B. Preservative Treated Materials:

- 1. Base:
 - a. Hoover Treated Wood Products.
- 2. Optional:
 - a. Arxada AG
 - b. Kopper Performance Chemicals.
 - c. Lonza Companies.
 - d. Stella-Jones, Inc.
 - e. Viance, LLC.
 - f. Western Wood Preservers, Ltd.

C. Metal Framing Anchors:

- 1. Base:
 - a. Simpson Strong-Tie
- 2. Optional:
 - a. United Steel Products

D. Other manufacturers desiring approval comply with Section 016100.

2.02 DIMENSION LUMBER

A. Dimension Lumber - General:

- 1. Provide dimension lumber of grades indicated according to ALSC National Grading Rule (NGR) provisions of inspection agency indicated.
- 2. Inspection agencies and abbreviations used to reference include following:
 - a. NELMA: Northeastern Lumber Manufacturers Association.
 - b. NLGA: National Lumber Grades Association.
 - c. RIS: Redwood Inspection Service.
 - d. SPIB: Southern Pine Inspection Bureau.

- e. WCLIB: West Coast Lumber Inspection Bureau.
 - f. WWPA: Western Wood Products Association.
3. Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.
 4. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece or omit grade stamps and provide grade compliance certificates issued by inspection agency.
 5. Where nominal sizes are indicated, provide actual sizes required by DOC PS20 for moisture content specified.
 - a. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 6. Provide dressed lumber, S4S, unless otherwise indicated.
 7. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2 inches nominal thickness or less, unless otherwise indicated.
- B. Other framing not listed above:
1. Provide following grade and species:
 - a. Grade: Construction, stud, or No.3.
- C. Exposed Framing:
1. Provide material hand-selected from lumber of species and grade indicated below for uniformity of appearance and freedom from characteristics that would impair finish appearance:
 - a. Species and grade: As indicated above for load bearing construction.
- D. Miscellaneous Lumber:
1. Provide lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members.
 2. Moisture content: 19 percent maximum for lumber items not specified to receive wood preservative treatment.
 3. Grade: For dimension lumber sizes, provide No.3 or Standard grade lumber per ALSC's NGRs of any species. For board size lumber, provide No.3 Common grade per NELMA, NLGA or WWPA; No.2 grade per SPIB, or Standard grade per NLGA, WCLIB, or WWPA of any species.

2.03 ENGINEERED WOOD PRODUCTS

A. Engineered Wood Products - General:

1. Provide engineered wood products acceptable to local building code authorities.
 - a. Provide engineered wood products with allowable design stresses, as published by manufacturer, which meet or exceed those indicated.
 - b. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
 2. Comply with APA (Engineered Wood Association) standards and recommendations.
- B. Concealed, performance rated structural use panels – General:
1. Plywood Quality:
 - a. Provide plywood panels complying with DOC PS1, U.S. Product Standard for Construction and Industrial Plywood, where plywood is indicated.
 2. Where structural use panels are indicated for following concealed types of applications, provide APA performance rated panels complying with requirements designated under each application for grade, span rating, exposure durability classification, and edge detail.
 - a. Panels shall have an APA trademark evidencing compliance with grade requirements.
 3. Thickness: Provide panels meeting requirements specified but not less than thickness indicated.
 4. Provide panels with span ratings required to meet Code Plus provisions of APA Form No. E30, APA Design/ Construction Guide: Residential and Commercial.
 5. Composite panels used inside building envelope shall be manufactured without urea-formaldehyde resins.
 6. Veneer core hardwood plywood shall have a formaldehyde emission no greater than 0.05 ppm.
 7. Composite core hardwood plywood shall have a formaldehyde emission no greater than 0.08 ppm.
- C. Roof Sheathing:
1. APA-Rated Sheathing.
 2. Exposure durability classification: Exterior.
 3. Span rating: As required to suit stud spacing indicated.

2.04 FASTENERS

- A. General:

1. Provide fasteners of size and type indicated that comply with requirements specified for material and manufacture.
 2. Where fasteners, nuts washers or connectors are in contact with pressure treated lumber, provide fasteners with a minimum hot-dip G90 galvanized coating per ASTM A153, ASTM B695, mechanical galvanized coating, silicon bronze, copper, and type 304 or 316 stainless steel fasteners when stainless steel connectors are used.
 3. Provide type 304 and 316 stainless steel fasteners at construction below grade, at swimming pools, where exposed to salt water environments, and severe exterior applications.
- B. Nails, wires, brads, and staples: FS FF-N-105.
- C. Deformed-shank Nails for Sheathing:
1. Corrosion-resistant for exterior exposures.
 2. Barbed or deformed shank.
 3. Comply with ASTM F1667.
- D. Power-driven fasteners: ICC ESR-1539.
- E. Wood Screws:
1. Carbon steel, galvanized, conforming to ASME B18.6.1 IFI 502.
- F. Lag screws or lag bolts:
1. Commercial steel, galvanized, conforming to ASME B18.2.1.
- G. Bolts and Nuts:
1. Carbon steel, galvanized, conforming to ASTM A307, Grade-A; ASTM-F568M, Class 4,8 or less.
 2. ASTM A563 hex nuts and flat washers.
- H. Metal Framing Anchors:
1. Provide galvanized steel framing anchors of structural capacity, type and size indicated and as follows:
 - a. Provide products for which model code research or evaluation reports exist that are acceptable to authorities having jurisdiction and that evidence compliance of metal framing anchors for application indicated with building code in effect for this project.
 - b. Provide products with allowable design loads as published by manufacturer, which meet or exceed those indicated.

- 1) Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- c. Galvanized steel sheet:
 - 1) Hot dip zinc-coated steel sheet complying with ASTM A653, coating designation as shown in the Application Matrix and Connection requirements.
- d. Structural, commercial, or lock-forming quality, as standard with manufacturer for type of anchor indicated.

2.05 TREATED MATERIALS

A. Wood Preservative Treated Materials:

1. The selection of preservative treated material is based on the exposure of the wood members: Interior, Exterior and Extreme Exterior use.
 - a. Extreme exterior use shall include exposure to ocean salty air, large bodies of water, fumes, fertilizers.
2. Application Matrix and Connection finish requirements:

Connector Material					
Wood Treatment	Interior Use		Exterior Use		Extreme Exposure
	No barrier	With barrier	No barrier	With barrier	No barrier
ACQ-C & ACQ-D	G185	G90	G185	G185	SS
CA-B & CBA-A	G185	G90	G185	G185	SS
DOT Sodium Borate	G90	No barrier required	Not allow.	Not allow.	Not allow.
Zinc Borate	G90	No barrier required	Not allow.	Not allow.	Not allow.
Other	SS	Not allow.	SS	Not allow	SS

Notes

Coating of fasteners shall match connector material.
 Barrier: Grace Vicar Deck Protection
 G90: Hot Dip Galvanized finish per ASTM-A153 Class G90
 G185: Hot Dip Galvanized finish per ASTM-A153 Class G185
 SS: Stainless Steel

B. Fire-Retardant Treated Materials - Exterior:

1. Use on Exterior Fire-rated assemblies; including items used within Fire-rated Exterior Walls.

C. Water-repellent preservative:

1. NWWDA tested and accepted formulation containing 3-iodo-2-propylene butyl carbonate (IPBC) as its active ingredient.

2.06 MISCELLANEOUS

A. Sill sealer gaskets:

1. Glass fiber resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32-inch.
2. Selected from manufacturer's standard widths to suit width of sill members indicated.

B. Adhesives for field gluing panels to framing:

1. Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by both adhesive and panel manufacturer.

C. Panel Edge Clips:

1. Extruded aluminum or galvanized steel, H-shaped clips to prevent differential deflection of roof sheathing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive work.
- B. Correct unsatisfactory conditions.
- C. Start of work constitutes acceptance of responsibility for performance.

3.02 PREPARATION

- A. Verify measurements, dimensions and drawing details before proceeding.
- B. Coordinate location of furring, nailers, blocking, grounds, and similar supports for attached work.
- C. Examine conditions under which work is to be installed.
- D. Correct unsatisfactory conditions.

3.03 INSTALLATION - GENERAL

A. General:

1. Provide wood grounds, nailers, or blocking as required for attachment of other work and surface applied items.
2. Provide wood blocking between studs at height of door stop, behind stop, at every door opening.
3. Grounds: Dressed, key beveled lumber minimum 1-1/2-inch wide of thickness required to bring face of ground even with finish material.
4. Remove temporary grounds when no longer required.

5. Install wood furring plumb and level with closure strips at edges and openings.
6. Shim as required.
7. Discard material with defects that impair quality of rough carpentry.
8. Set rough carpentry to required levels and lines with members plumb, true to line, cut and fitted.
9. Fit rough carpentry to other construction; scribe and cope as required for accurate fit.
 - a. Coordinate location of furring, nailers, blocking, grounds, and similar supports to allow attachment of other construction.
10. Apply field treatment complying with AWWPA M4 to cut ends of preservative treated lumber and plywood.
11. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated on Drawings and complying with following:
 - a. CABO NER-272 for power driven staples, P-nails, and allied fasteners.
 - b. Published requirements of metal framing anchor manufacturer.
12. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials.
 - a. Make tight connections between members. Install fasteners without splitting wood; pre-drill as required.
13. Use hot-dip galvanized or stainless steel nails where rough carpentry is exposed to weather in-ground contact or in areas of high humidity.
14. Countersink nail heads on exposed carpentry work and fill holes with wood filler.
15. Comply with AWC's "Manual for Wood Frame Construction," unless otherwise indicated.
16. Install engineered wood products to comply with manufacturer's written instructions.
17. Install framing members of size and at spacing indicated.
18. Do not splice structural members between supports.

3.04 INSTALLATION – ENGINEERED WOOD PRODUCTS

A. General:

1. Comply with applicable recommendations contained in APA Form No. E30, APA Design/Constructing Guide: Residential & Commercial, for types of structural use panels and applications indicated.

2. Space panels 1/8-inch at edges and ends.
 3. Utilize framing clips along long edges.
- B. Fastening: As indicated and as follows:
1. Roof Sheathing:
 - a. Install with the grain of the outer plies or long dimension at right angles to framing supports.
 - 1) Stagger end joints and locate over the centerlines of supports.
 - b. Allow 1/8-inch spacing at panel ends and 1/4-inch at panel edges.
 - 1) Utilize Panel Edge Clips along long edges of sheathing, between framing members.
 - c. Nail or Screw to framing.
 - 1) Nailing:
 - a) Nail panels with 8-penny common nails or 6-penny annular rings or screw-type nails spaced 6 inches O.C. at supported edges and 12 inches O.C. at intermediate bearings.
 - b) Set nails no less than 3/8 inches from edges.
 - 2) Screwing:
 - a) Where framing is metal trusses: Use appropriate screw type spaced as specified above for nails.
 - 3) Do not use staples in roof sheathing.
 - d. Where the support spacing exceeds the maximum span for an unsupported edge, provide adequate blocking, tongue-and-groove edges, or panel edge clips, in accordance with APA E30.

3.05 PROTECTION – ENGINEERED PANEL PRODUCTS

- A. Protect installed sheathings from moisture damage.
1. Replace panels that show warped or swelling.

END OF SECTION

SECTION 07190

VAPOR BARRIER

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install a vapor barrier to be placed under all reinforced concrete placed against soil as specified herein or shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 03300 - Cast-in-Place Concrete

PART 2 - PRODUCTS

2.01 VAPOR BARRIER

- A. Vapor Barrier: A reinforced laminate membrane with a minimum tensile strength of 75 lbs/in. in accordance with ASTM D-882, vapor transmission rating of 0.02 perms in accordance with E-96, and a puncture resistance of 25 lbs in accordance with ASTM D 4833.
- B. Adhesive/Tape: Type approved by the Manufacturer of the vapor material.
- C. Penetration sealing: Provide manufacturer's recommended penetration seals at all pipe, conduit, and similar penetrations.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products from one of the following manufacturers:
 - 1. Viper Vapercheck 10 by Insulation Solutions, Inc.
 - 2. Griffolyn Type-85, by Reef Industries, Inc.
 - 3. Or Equal

PART 3 - EXECUTION

3.01 VAPOR BARRIER

- A. Vapor barrier shall be placed on top of 4 inches minimum of compacted structural fill stone, free of debris and protrusions, as shown on the Drawings for structural slabs.
- B. Lap edges 12 inches and seal with adhesive tape. Lay with seams perpendicular to and lapped in the direction of placement. Do not penetrate vapor barrier.

- C. Protect from damage until concrete is placed. Punctures and tears in vapor barrier shall be repaired using patches of the material which overlaps puncture or tear a minimum of 12 inches; seal with tape or adhesive.
- D. Penetrations through vapor barrier, such as pipe, drains, conduits and similar penetrations, shall be sealed in strict accordance with manufacturer's recommended instructions.

END OF SECTION

SECTION 07210
THERMAL INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Building Insulation in accordance with provisions of Contract Documents.
- B. Section 01 81 13. Completely coordinate with work of other trades.

1.02 REFERENCES

A. Referenced Standards:

- 1. ASTM International (ASTM):
 - a. C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - b. C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - c. C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - d. C1104/C1104M Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 - e. D696 Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 deg C and 30 deg C with a Vitreous Silica Dilatometer.
 - f. E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - g. E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - h. E96/E96M Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
 - i. E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - j. E136 Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 deg C
 - k. E605/E605M Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.
- 2. National Fire Protection Association (NFPA):

- a. NFPA 268 Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source
- b. NFPA 285 Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: Manufacturers' product data sheets, details and installation instructions including components and accessories, indicating product complies with specifications.

B. Informational Submittals:

1. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.04 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Mineral Fiber Insulation:

1. Base:
 - a. Thermafiber, Inc., an Owens Corning company.
2. Optional:

- a. Rockwool.
- b. Johns Manville.
- c. Knauf.

B. Fiberglass Batt Insulation:

- 1. Base:
 - a. Owens-Corning.
- 2. Optional:
 - a. CertainTeed
 - b. Johns Manville.
 - c. Knauf Insulation.

C. Other Materials:

- 1. Base:
 - a. As indicated.

D. Other manufacturers desiring approval comply with Section 01610.

2.02 SECTION 01 81 13.MATERIALS

A. Mineral Fiber Insulation:

- 1. Unfaced, non-combustible, water repellant, semi-rigid fiber insulation board.
- 2. Temperature Resistance: Per ASTM C612.
 - a. Over 2000 deg F.
- 3. Surface Burning Characteristics per ASTM E84.
 - a. Flame Spread: 0.
 - b. Smoke Developed: 0.
- 4. Moisture Resistance: Absorbs less 0.03 percent by volume, per ASTM C1104.
- 5. R-value: 4.2 per inch.
- 6. Density: 4.5 pcf.
- 7. Non-corrosive per ASTM C665.
- 8. Thickness: As noted in drawings.
- 9. Base Product: Thermafiber RainBarrier 45 Insulation.
- 10. Mechanical fasteners; impaling clips/pins:

- a. Pronged hangers and slotted washers or arrow pointed hangers.
- b. Size pins to fit insulation thickness.
- c. Base Product: GEMCO as manufactured by Goodloe E. Moore.
 - 1) Gemco pronged hanger with pronged washer.

11. Mastic for use with mechanical fasteners:

- a. Base Product: As approved by fastener manufacturer.

B. Unfaced Fiberglass Batt Insulation

1. Inorganic fibers and resinous binders formed into flexible blankets or semi-rigid sheets.
2. Un-faced, Type I in accordance with ASTM C665.
3. Minimum Surface Burning Characteristics per ASTM E84: Flame Spread: Less than 25; Smoke Developed: Less than 50.
4. Combustion characteristics: Noncombustible; unfaced per ASTM E136.
5. Manufactured without urea-formaldehyde binders.
6. Nominal Thickness / Thermal Resistance Value, measured at 75 deg F:
 - a. Nominal Thickness: 6-1/2 inches / R-19.
 - b. Nominal Thickness: 3-5/8 inches / R-13.
 - c. Nominal Thickness: 8-1/4 inches / R-25.
 - d. Nominal Thickness: 10-1/4 inches / R-30.
 - e. Nominal Thickness: 13 inches / R-38.
7. Minimum 25 percent total recovered material content per EPA/CPG guidelines.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify suitability of substrate to accept installation.
- B. Installation indicates acceptance of responsibility for performance.

3.02 INSTALLATION

- A. General:
 1. Insulate full thickness over surfaces to be insulated.
 2. Fit tightly around obstructions, fill voids.

3. Cover penetrations with insulation.
 4. Comply with manufacturer's instructions for installation unless more stringent requirements are specified.
 5. Consult manufacturer's technical representative if installation instructions are not applicable.
 6. Where rigid insulation is indicated over 2 inches thick, apply in double layer with staggered joints to achieve total thickness.
 7. Do not use broken or torn pieces of insulation.
 8. Provide minimum cover of 5/8 inches type X gypsum wallboard or approved ignition barrier over exposed foam surfaces.
- B. Un-Faced Batt Insulation and Vapor Retarder in exterior Stud Wall systems:
1. Installing Batts:
 - a. Friction fit un-faced batts between studs.
 - b. Tightly butt ends.
 - c. Where specified thickness of batts is less than the depth of framing, install retaining devices to prevent sagging.

3.03 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

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SECTION 07301

ROOFING UNDERLAYMENT, HIGH-TEMPERATURE

Grace Ice & Water Shield® HT Grace Ice & Water Shield® HT designed for use in demanding high temperature (HT) applications where temperature resistance up to 260F is required. Excludes applications in high altitudes where copper, zinc or Cor-Ten roof coverings will be used.

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section specifies a self-adhering sheet membrane used as underlayment for sloped roofs.
 - 1. High temperature application, 260F resistance, Grace Ice & Water Shield® HT.
- B. Related Sections: Refer to the following specification sections for coordination:
 - 1. Section 061000 - Rough Carpentry.
 - 2. Section 07320 - Roof Tiles.
- C. Referenced Standards Comply with the requirements of the following standards published by ASTM International to the extent referenced in this section.
 - 1. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
 - 2. ASTM D461 - Standard Test Methods for Felt.
 - 3. ASTM D 903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
 - 4. ASTM D1970 - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - 5. ASTM D3767 - Standard Practice for Rubber—Measurement of Dimensions.
 - 6. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
 - 7. ASTM G90 – EMMAqua test.

1.02 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions.

1.03 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements of authorities having jurisdiction and applicable codes at the location of the project.
- B. Manufacturer: Minimum 10 years experience producing roofing underlayment.
- C. Installer: Minimum 2 years experience with installation of similar underlayment.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Protect from damage.
- B. Cover materials and store in dry condition between temperatures of 40 and 90 degrees F (5 and 32 degrees C). Use within one year of date of manufacture. Do not store at elevated temperatures as that will reduce the shelf life of the product.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Manufacturer: GCP Applied Technologies, Inc., 62 Whittemore Avenue, Cambridge, MA 02140, Toll Free 866-333-3726, www.gcpat.com.

2.02 MATERIALS

- A. Self-Adhering Sheet Membrane Roof Underlayment: Provide Grace Ice and Water Shield HT by GCP Applied Technologies, Inc with the following characteristics:
 - 1. Material: Cold applied, self adhering membrane composed of an innovative and proprietary rubberized asphalt adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is provided on the high performance film with UV barrier properties.
 - 2. Membrane Thickness: 40 mils (1.02 mm) per ASTM D3767 Method A.
 - 3. Membrane Tensile Strength: MD 33 lbf/in, CD 31 lbf/inch per ASTM D412 Die C Modified.
 - 4. Membrane Elongation: 250% per ASTM D412 Die C Modified.
 - 5. Low Temperature Flexibility: Unaffected at -20 degrees F (-29 degrees C) per ASTM D1970.
 - 6. Adhesion to Plywood: 5.0 lb/in. width (876 N/m) per ASTM D903.
 - 7. Maximum Permeance: 0.05 perms (2.9 ng/sgms Pa) per ASTM E96.
 - 8. Maximum Material Weight Installed: 0.22 pounds/sqft (1.1 kg/sqm) per ASTM D461.
 - 9. Service Temperature: 260 degrees F (115.6 degrees C) per ASTM D1204
 - 10. Compatibility: Suitable for use under all types of sloped roofing with the exception high altitude climates where zinc, copper or Cor-Ten roof coverings are used.
 - 11. Adhesive: Rubberized asphalt adhesive containing post-consumer recycled content, contains no calcium carbonate, sand or fly ash.
 - 12. Exposure: Can be left exposed for a maximum of 120 days from date of installation per ASTM G90 – EMMAqua test.
 - 13. Primer: Water-based Perm-A-Barrier WB Primer by GCP Applied Technologies, Inc.
 - 14. Code and Standards Compliance: Grace Ice and Water Shield HT meets the following requirements:

- a. ASTM D1970.
- b. ICC-ES ESR-3121, per AC 48 Acceptance Criteria for Roof Underlayments used in Severe Climate Areas.
- c. Underwriters Laboratories Inc. R13399 - Class A fire classification under fiber-glass shingles and Class C under organic felt shingles (per ASTM E108/UL 790).
- d. Underwriters Laboratories Inc. Classified Sheathing Material Fire Resistance Classification with Roof Designs: P225, P227, P230, P237, P259, P508, P510, P512, P514, P701, P711, P717, P722, P723, P732, P734, P736, P742, P803, P814, P818, P824
- e. Miami-Dade County Code Report NOA #15-0728.11
- f. Florida State Approval Report No. FL289-R3
- g. CCMC Approval No. 13671-L

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to start of installation, inspect existing conditions to ensure surfaces are suitable for installation of roofing underlayment. Verify flashing has been installed. Starting work indicates installers acceptance of existing conditions.

3.02 INSTALLATION

- A. Installation: Install roofing underlayment on sloped surfaces at locations indicated on the Drawings, but not less than at hips, ridges, eaves, valleys, sidewalls and chimneys, and surfaces over interior space within 36 inches (914 mm) from the inside face of the exterior wall. Strictly comply with manufacturer's installation instructions including but not limited to the following:
 1. Schedule installation such that underlayment is covered by roofing within the published exposure limit of the underlayment.
 2. Do not install underlayment on wet or frozen substrates.
 3. Install when surface temperature of substrate is a minimum of 40 degrees F (5 degrees C) and rising.
 4. Remove dust, dirt, loose materials and protrusions from deck surface.
 5. Install membrane on clean, dry, continuous structural deck. Fill voids and damaged or unsupported areas prior to installation.
 6. Prime concrete and masonry surfaces using specified primer at a rate of 500-600 square feet per gallon (12-15 sqm/L). Priming is not required for other suitable clean and dry surfaces.
 7. Install membrane such that all laps shed water. Work from the low point to the high point of the roof at all times. Apply the membrane in valleys before the membrane is applied to the eaves. Following placement along the eaves, continue application of the membrane up the roof. Membrane may be installed either vertically or horizontally after the first horizontal course.

8. Side laps minimum 3-1/2 inches (89 mm) and end laps minimum 6 inches (152 mm) following lap lines marked on underlayment.
9. Patch penetrations and damage using manufacturer's recommended methods.

3.03 CLEANING AND PROTECTION

- A. Protection: Protect from damage during construction operations and installation of roofing materials. Promptly repair any damaged or deteriorated surfaces.
- B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired in the opinion of the Architect.
- C. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protective film and reclean as necessary immediately before final acceptance.

END OF SECTION

07301

ROOFING UNDERLAYMENT HIGH TEMPERATURE
5

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SECTION 07320
BARREL STYLE METAL TILE

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- A. Metal Barrel Tile facsimile roofing panels.
- B. Roof trim, flashing, and other accessories required providing a complete and weather tight roofing system.

1.02 RELATED SECTIONS:

To include and/or coordinate with related work specified elsewhere:

- A. Section 05140 – Structural Aluminum
- B. Section 07220 – Roof Insulation
- C. Section 07301 – Roofing Underlayment High Temperature
- D. Section 07600 – Flashing and Roofing Accessories
- E. Section 07920 – Sealants and Caulking

1.03 REFERENCES:

- A. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. ASTM A755/A755M – Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil Coating Process for Exterior Exposed Building Products.
- C. ASCE 7-98 – Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers.
- D. Miami-Dade County Protocol TAS 301 for laboratory tests and test reports.

1.04 PERFORMANCE REQUIREMENTS

- A. Panel system shall be designed to safely resist the positive and negative loads as specified.
- B. Design and size components to withstand load caused by wind pressures as specified in ASCE 7-98 per S.F.B.C.
- C. Tested in accordance with Miami-Dade Protocol TAS 301.
 - 1. Accelerated Testing of coating 2,000 hours per ASTM G23.
 - 2. Salt Spray Testing of coating 1,000 hours per ASTM B117.

3. Fire Testing per ASTM E108 or UL790. (Not required if system is assembled with an approved fire barrier.)
 4. Uplift Resistance Test per TAS 125. (UL 580 Class 90 or higher. The permanent deformation area, at any location, shall not exceed the area of a 1" diameter circle.)
 5. Wind Driven Rain Test per TAS 100. (If system is to include a valley assembly and/or horizontal joints, the valley assembly and/or two horizontal joints shall be incorporated in TAS 100 test.)
- D. System Movement – Accommodate movements due to thermal expansion and contraction, dynamic loading, and deflection of structural support system without damage to panel system or loss of weatherproofing capability.
- E. Fabricate panels in full length with no end laps when panel lengths are 30'-0 or less. The use of end laps shall be acceptable for length's greater than 30'-0. Manufacturer's details for end lap conditions shall be strictly adhered to.
- F. All panels shall be fastened to the framing members or substrate in accordance with manufacturer instructions.
- G. Roof panels, fasteners, closures, flashings, and all accessories shall be the product of a single manufacturer.
- H. All trim and flashings components shall be fabricated in lengths of 10'-0" to minimize joint details. Allowance for thermal expansion and contraction of trim and flashing components shall be incorporated in their design.
- I. Drainage – Provide positive drainage to exterior to prevent moisture from entering building enclosure or condensation occurring within exterior building envelope.

1.05 SUBMITTALS

- A. Submit under provisions of Section 0130, "Submittals".
- B. Manufacturer's Certifications: Certified statement that the manufacture has a minimum of seven (7) years experience in the roll forming process of metal panel systems.
- C. Product Data: Manufacturer's current product specifications and installation instructions.
- D. Test Reports: Submit the following test reports, certified by an independent testing laboratory or independent professional engineer, to verify that the proposed materials will meet the performance criteria of the specification.
 1. Fastener pull-out test and calculations.
 2. Coating quality.
- E. Shop Drawings: Prior to fabrication, contractor is to submit drawings showing a small-scale roof plan and/or elevations, as required. Show details of trim and flashing conditions, fastening and anchoring methods, weatherproofing techniques,

terminations, and penetrations of metal roofing work. Panel installation shall not start until drawing approval by architects.

- F. Selection Samples: Submit samples of the following: metal panel, fasteners, closures, sealant and actual metal chips with full range of colors (minimum of twenty) available for Architect's selection.
- G. Verification Samples: Submit two samples of each type of metal panel required, not less than 16-inches, and illustrating finished panel profile, color, gloss, and texture.
- H. Upon bid proposal contractor is to provide qualifications and/or exceptions to the drawings and specifications.
- I. Contract Closeout Submittal: Coordinate with Section 01700. Submit specified warranties, maintenance instructions, and other closeout submittals pertaining to this section.

1.06 QUALITY ASSURANCE

- A. All panels are to be factory formed and packaged as per job requirements.
- B. Specification is based upon the products of Florida Metal Roofing Products, Inc. No other manufacturer of metal panel systems shall be accepted as an alternate product.
- C. Manufacturer Qualifications: Minimum of 7 years of experience in factory-fabrication and roll forming of metal panels.
- D. Installer Qualifications: Company specializing in the type of work required for this project, with not less than 2 years of documented experience applying this type of panel system with successful completion of projects of similar scope.
- E. Pre-installation Meeting: Convene meeting between panel installer, general contractor, and architect not less than one week prior to beginning installation to review the following: acceptable substrates, materials, colors, gauges, changes in scope of work, etc.
- F. Regulatory Requirement: All local building code requirements are to be followed for both design and installation of metal panel system.
- G. Field Measurements: The installer must obtain actual project field verifications to ensure dimensional correctness. These verifications must be preformed prior to providing the manufacturer with a bill of material.
- H. Source Quality Control: Provide actual test criteria and/or calculations where applicable pertinent to design criteria within project specifications.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Comply with provisions of Section 01600.
- B. Order materials based on field measurements, not on construction drawings.
- C. Package panels at factory.

- D. Installer shall coordinate with general contractor as to scheduled delivery time after receipt of field verified bill of material by manufacturer as it related to actual project scheduling.
- E. Delivery of materials shall be made only when suitable facilities for storage and protection are made available.
- F. Upon receipt of delivery of metal panel system and prior to signing the delivery ticket, the installer is to examine each shipment for damage and for completion of the consignment.
- G. Protect materials from damage during transit and at storage facility or project site.
- H. Store in a dry environment to prevent water damage from the elements and condensation. Store panels to allow for positive drainage in the event that materials are exposed to moisture.
- I. Do not expose panels and/or flashings with strippable protective film to direct sunlight or extreme heat.
- J. Do not allow storage of other trade materials or staging of other work on finished product.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Design is based on products manufactured by Florida Metal Roofing Products, Inc., 1225 Hill Avenue, Mangonia Park, FL 33407. Phone (561) 863-FMRP (3677) and Fax (561) 863-3675. Miami-Dade County NOA 16-0125.09
- B. Provide panels, fasteners, closures, flashings, and accessories supplied by a single manufacturer.
- C. Substitutions: No substitutions are to be accepted.

2.02 PANEL SYSTEM

- A. Roof Panel Systems: Provide factory formed metal panel systems with all necessary components to ensure a weather tight installation, including but not limited to ridges, hips, valleys, eaves, rakes, corners, and miscellaneous flashings.
- B. Materials: Florida Metal's Barrel Style Metal Tile Panel
 - 1. Gauge: 24 Gauge (.025" min.) G90 Galvanized Steel
 - 2. Panel Width: 44-inches with a 40-inch coverage
 - 3. Panel Length: Panel length as indicated on drawings
 - 4. Tile Configuration: 2-1/2-inch high barrel style with a 5/8-inch step located between 12-inches and 16-inches.

5. Texture: Smooth or Embossed
6. Finish: Kynar 500/Hylar 5000 (30 Gloss)

2.03 MATERIALS

- A. Pre-coated Galvanized Steel Sheet: ASTM A 755/A 755M; ASTM A 653/A 653M, Structural Quality Grade 33/230, G90 Coating Designation, pre-coated with Kynar 500®/Hylar 5000®finish.
- B. Aluminum Sheet: ASTM B 209, minimum yield strength 17,000 psi (117 Mpa). Pre-finish as specified under panel type.
- C. Fluoropolymer Coating: Provide multi-coat PVDF Kynar 500® or Hylar 5000®finish system on exposed metal surfaces.
 1. The pre-finished coating system fluoropolymer Kynar 500® or Hylar 5000® must reflect the following performance characteristics in accordance with ASTM procedures:
 - a. Dry Film Thickness (Nominal): ASTM D-1400-87, D-1005-84 (1990) Eddy current device or micrometer – consists of 0.2 +/-0.05 mil primer on both sides with a 0.8 +/-0.1 mil 70% Kynar 500®or 70% Hylar 5000®topcoat.
 - b. Gloss: ASTM D-523-89 at 60° – Standard shall have a gloss of 30.
 - c. Pencil Hardness: ASTM D-3363-92a Eagle Turquoise Drafting Lead HB minimum.
 - d. Formability T-Bend: ASTM D-4145-90 No cracking or tape removal of film at 1-T bend (aluminum); 2-T bend (coated steel).
 - e. Formability Mandrel: ASTM D-522-93a 180° bend around a 1/8" mandrel – No cracking or loss of adhesion.
 - f. Adhesion: ASTM D-3359-93 Rev. impacted 1/16" crosshatch – No adhesion loss.
 - g. Reverse Impact: ASTM D-2794-93 Impact in in./lb. = 1.5 x metal thickness in inches (aluminum) or 3 x metal thickness in inches (coated steel) – No cracking or loss of adhesion.
 - h. Abrasion Resistance, Falling Sand Test: ASTM D-968-93 Liters to expose 5/32" of substrate – 67 liters +/- 10 liters.
 - i. Acid Pollutants Resistance Test: ASTM D-1308 Procedure 7.2 (Independent of Substrate). 10% Hydrochloric Acid 24 hour – No visible change, 20% Hydrochloric Acid 18 hour – No visible change, 20% Sulfuric Acid 18 hour – No visible change, 25% Sodium Hydroxide 1 hour – No visible change, 20% Muriatic Acid 15 minutes – No visible change.

- j. Humidity Test: ASTM D-2247-92 100% Relative Humidity at 90° F – Passes 3,000 hours (aluminum) with no blisters; passes 2,000 hours (coated steel) with no blisters.
 - k. Salt Spray Test: ASTM B-117 1,000 hours –
 - l. Aluminum – Scribe: 10 – No Creepage, Field: 10 No Blisters
 - m. Coated Steel – Scribe: 7 – 1/16" Blisters, Field: 10 – No Blisters.
 - n. Accelerated Weathering: ASTM G-23 2,000 hours, Chalk: #8, Color: 2ΔE
2. The exterior color of 70% Fluoropolymer Finish shall be chosen from manufacturer's standard colors.

2.04 ACCESSORIES

- A. Provide formed accessories of same gauge and finish as the primary panel system, unless otherwise indicated on the drawings, compliant with specified requirements.
- B. All flashing components shall be fabricated in a minimum of 10'-0" lengths.
- C. Sealants:
 - 1. As specified in Section 07920.
 - 2. Apply sealant where necessary to complete a weather tight roof system.
 - 3. Consult manufacturer for sealant recommendations.
- D. Fasteners: As recommended by manufacturer for project conditions and panel type.

2.05 FABRICATION

- A. Panels shall be factory fabricated.
- B. Fabricate panels up to 30'-0 long in one piece without transverse seams. Panels over 30'-0 may be fabricated with seams; use manufacturer's standard end lap details.
- C. Factory – fabricate trim and flashing components in minimum 10'-0" lengths, with allowance for thermal movement in joint design; unless project site conditions prohibit such.
- D. Clips and related accessory items to be supplied by panel manufacturer as a single source responsibility.
- E. Form all components true to shape, accurate in size, square, free from distortion or defects. Cut panels to precise lengths indicated on approved shop drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect substrates to verify that they are in proper condition, spaced correctly, plumb, and are ready to receive panels and accessories.
 - 1. Notify the architect in writing if substrates are not suitable for application of panel system.
 - 2. Do not proceed with installation until substrates are acceptable.
- B. Verify actual dimensions in field prior to ordering material.

3.02 INSTALLATION

- A. Install metal panels and accessories in strict accordance with manufacturer's instructions, shop drawings, and applicable building codes.
- B. Protect surfaces from coming in contact with cementitious materials and dissimilar metals with a neutral coating such as bituminous paint.
- C. Fasten panels to structural supports as per manufacturer's recommendations.
- D. Entire system shall be installed plumb, level, and true to line.
- E. Fully interlock or overlap panels (dependent upon panel design) with adjacent panels; apply sealant as recommended by panel manufacturer to achieve weather tight installation.
- F. Roll formed panels designed for eave to ridge installation should be installed with no transverse seams.
- G. Workmanship complies with standards established by the Architectural Sheet Metal Community.
- H. Care should be taken during handling of panels to prevent bending, twisting, abrasion, scratching, denting, etc.
- I. Do not allow shavings, metal dust, or chips to fall on panels.

3.03 ADJUSTING AND CLEANING

- A. Remove all protective masking from material immediately after installation.
- B. Touch up only minor abrasions with matching paint provided by panel manufacturer. Remove and replace panels that cannot be satisfactorily touched up.
- C. Sweep and remove chips, shavings, and dust from roof on a daily basis during installation period. Leave installed work clean, free of grease, finger marks and stains.
- D. Upon completion of installation, remove scraps and debris from project site.

3.04 PROTECTION

- A. Provide protection as required to assure that completed work of this section will be without damage or deterioration at date of substantial completion.
- B. Protect work area as required to protect from damage by other trades.
- C. Safety clothing, equipment, and precaution must be utilized according to safety standards.

END OF SECTION

SECTION 07600

FLASHING AND ROOFING ACCESSORIES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install roofing sheet metal work and related items necessary for a complete installation, as indicated on the Drawings and specified herein, including, but not limited to the following: base flashings; pitch pans, scuppers, and other sheet metal work in conjunction with roof drainage; pipe and stack flashings, and similar items where furnished by equipment suppliers; flashings for ducts, exhaust piping, equipment piping, conduit, etc., penetrating roofing that may be required.

1.02 SUBMITTALS

- A. Submit shop drawings and samples for review in accordance with Section 01300 entitled "Submittals". Provide sizes, shapes, thicknesses and types of materials, finishes fabrication details, anchors, connections and expansion joints in relation to adjacent work.
- B. Submit a 12-inch square sample of wall flashing, angle clamping bar and other metal work specified. Deliver samples to a field location as directed by the Engineer.

1.03 APPLICABLE STANDARDS

- A. Except as otherwise shown or specified, comply with applicable manual by (SMACNA) Sheet Metal and A/C Contractors National Association.
- B. Except as otherwise shown or specified, comply with the recommendations and instructions of the manufacturer of the sheet metal being installed.
- C. All materials and installation shall conform to or exceed the requirement of all local codes.

1.04 GUARANTEE

- A. The roofing guarantee specified in Section entitled "Built-Up Bituminous Roofing" shall cover flashings and accessories specified in this section. The flashing and edge details shall be as required by the roofing manufacturer to satisfy conditions of the guarantee. The details shown on the Drawings are intended to provide minimum standards required for the guarantee.
- B. All roofing accessories, including flashing, fasteners, roof vents, curb details and other miscellaneous metals and accessories required for the installation shall be supplied by the roofing manufacturer or from other sources acceptable to the manufacturer selected for the installation so that the system guarantee will include all edges, penetrations and other details of the installation.

PART 2 - PRODUCTS

2.01 FLASHING

- A. Flashing shall be 0.040-inch aluminum, minimum. The system shall be Presto Lock Facia System by Johns Manville, or equal.
- B. Coping system shall be Presto Lock coping System by Johns Manville, or equal.

2.02 CANT STRIPS

- A. Cant Strips shall be Fes-Cant Plus Cant Strip by Johns Manville or equal. Trips shall be a high density, laminated board made of high strength fibers and expanded peslites.

2.03 ROOF VENTS

- A. Roof vents shall be provided for all roofing applications. One vent per 1000 square feet of applications shall be provided. One vent per 1000 square feet of roofing area shall be provided. The vents roofing area shall be provided. The vents shall be FP-10 One Way Roof Vents by Johns Manville or equal.

2.04 PLASTIC CEMENT

- A. Plastic cement shall conform to ASTM D 2822 and shall be supplied by the roofing manufacturer.

2.05 FASTENERS

- A. Nails, bolts, and nuts, screws, washers, etc., shall be stainless steel and shall be supplied by the roofing manufacturer.

2.06 ANCHORS

- A. Anchors for fastening items to concrete shall be stainless steel machine screws or bolts and Rawl plug inserts of Phillips Red Head concrete anchors of the size and type noted or required.

2.07 BITUMINOUS PLASTIC CEMENT

- A. Bituminous plastic cement shall conform to FS SS-C-153.

2.08 ASPHALTIC MATERIAL

- A. Asphalt primers shall conform to FS S-A-701. Coating asphalt shall have brushing consistency conforming to FS SS-R-451.

2.09 SCUPPERS, GUTTERS AND DOWNSPOUTS

- A. Material: Minimum 0.050 inch thick aluminum.
- B. Design: Manufacture gutters tapered and notched to provide telescoping joint. Design gutters and downspouts to accommodate expected thermal movement.
- C. Supports and Fasteners: Provide manufacturers' standard straps, brackets and fasteners, spaced at maximum 60-inches on center or as recommended by the

manufacturer. Finish of supports, brackets and fasteners shall match gutter and downspout.

- D. Accessories: Provide end caps, flashing, trim, and other items required for a complete installation.
- E. Finish: Baked on Kynar, with 20 year warranty.
- F. Color: Color for the downspout shall be selected by the Engineer from the Supplier's standard color chart.

PART 3 - EXECUTION

3.01 SHIPPING, HANDLING AND STORAGE

- A. Store materials off the ground to avoid damage. Protect from bitumen spillage and repair or replace damage at no additional cost to the City.

3.02 JOB CONDITIONS

- A. Coordination: Coordinate with the roofing system, sheet metal, plumbing, electrical, HVAC and mechanical subcontractors to insure that all items are in place prior to commencement of work.
- B. Climatic Conditions: Proceed with the roofing and associated work only when existing and forecasted weather conditions will permit the work to be performed as scheduled.

3.03 SHEET METAL INSTALLATION

- A. General: Coordinate metal flashing and trim work with the installation of roofing, waterproofing, piping, existing building, and other adjoining and substrate work. Surfaces to be coated shall be smooth and clean. The installer must examine the substrate and the conditions under which the metal flashing will be installed, and notify the Contractor in writing of any unsatisfactory conditions. Do not proceed with installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer. Flanges or gravel stops, vent and other flashings, shall be bedded in hot asphalt, set on top of the roofing plies and reinforced with felt strips as specified. Work shall be water tight, with lines, arises and angles sharp and true. Surfaces shall be free from waves and buckles.
- B. Fabrication: Fabricate and install work described herein in accordance with the applicable standard described and illustrated in the National Association, Inc. publication "Architectural Sheet Metal Manual".
- C. Flashings: Base and all other flashings shall be watertight and of a bondable type.
- D. Scuppers: Scuppers and the like, shall be fabricated as indicated on the Drawings, or equal, and properly installed.
- E. Accuracy: Fabricate and install work with lines and corners of exposed units true and accurate. Form exposed faces flat and free from buckles, excessive waves and avoidable tool marks, considering the temper and reflectivity of the metal. Provide uniform, neat seams with minimum exposure of solder welds, and sealant. Except as

otherwise shown, fold back the sheet metal to form a hem on the concealed side of exposed edges.

- F. Fasteners: Conceal fasteners and expansion provisions wherever possible in exposed work, and locate so as to minimize the possibility of leakage. Cover and seal work as required for a tight installation. Fasten sheet metal items as indicated or required to provide rigid, secure installation free of warp. Fastenings shall be made in such a manner as not to impair the watertight integrity of the installation. Exposed face nailing will not be permitted.
- G. Laps: For embedment of metal flanges in roofing or composition flashing or stripping, extend flanges for a minimum of 4-inch embedment. Lap seams of sheet metal in direction of flow. Single lock flat seams, heliarc weld or double-lock and mallet flat. Lap seams occurring in members sloping 45 degrees or greater shall be lapped 4-inch minimum and be bedded in flashing cement. Provide loose-locked expansion joints a maximum of 20 feet and a minimum of 8 feet from corners. On vertical surfaces, lap 2 piece flashings a minimum of 3 inches.
- H. Protection: Separate dissimilar metals from each other by painting each metal surface in the area of contact with a heavy application of bituminous coating, or by other permanent separation as recommended by the manufacturers of the dissimilar metals. The flashing subcontractor shall advise the Contractor of required procedures for protection of the completed flashing and trim. Furnish such advice for period of installation of other work, and also for the remainder of the construction period.

3.04 COORDINATION

- A. Coordinate flashing work with the work of other trades. Adjacent work shall be kept clean and shall not be injured or defaced in any way.

3.05 PROTECTION AND CLEANING

- A. The Contractor shall protect the work of other trades. Work damaged by an operation under this section shall be repaired or replaced at no expense to the City. All soiled adjoining surfaces shall be carefully cleaned.
- B. All debris and surplus material resulting from work under this section shall be removed from the premises.

END OF SECTION

SECTION 07920

SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall provide sealant and caulking work required for a complete installation as is indicated on the Drawings and specified herein. The required applications of sealants and caulking include, but are not necessarily limited to, the following general locations:
1. Masonry joints, exterior and interior.
 2. Joints at penetrations of walls, decks by piping, doors, windows, louvers and other services and equipment.
 3. Joints between items of equipment and other construction.
 4. Joints in concrete.

1.02 SUBMITTALS

- A. Submit shop drawings and color samples of sealant for review in accordance with the Section entitled "Submittals".
- B. Submit a two year guarantee on sealant type caulking work against joint failure. Joint failure is defined as leaks of air or water; evidence of loss of cohesion; fading of sealant material; migration of sealant; evidence of loss of adhesion between sealant and joint edge.

1.03 ACCEPTABLE MANUFACTURERS

- A. The following list of manufacturer products are acceptable for this Section, subject to conformance with the specified requirements: Tremco, Thiokol, Dymoric or equal.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Primer: Where required by sealant manufacturer, the primer shall be a compound designed to insure the adhesion of sealant. Material shall be provided by the sealant manufacturer and shall be selected for compatibility with substrate.
- B. Sealant
1. Type 1: Multi-component, non-sag, low-modulus polyurethane rubber sealant meeting ASTM C-920, Type M, Grade NS, Class 25, use NT, M, A, and O. Capable of withstanding 50% in extension or compression such as Sikaflex-2C NS/SL, Sika Corporation, or approved equal.

2. Type 2: Single component polyurethane sealant meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, A, and O. Capable of withstanding 25% in extension or compression such as Sikaflex 1A by Sika Corporation or approved equal.
 3. Type 3: Single component, low-modulus moisture curing silicone meeting ASTM C 920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Capable of withstanding 50% extension and compression. Pecora 890 by Pecora Corporation, or approved equal.
 4. Type 4: Single component, mildew resistant, moisture-curing silicone meeting ASTM C-920, Type S, Grade NS, Class 25, Use NT, M, G, and A. Pecora 898 by Pecora Corporation, or approved equal.
 5. Type 5: Single component, acrylic latex meeting ASTM C-834. AC-20+ Silicone by Pecora Corporation, or approved equal.
 6. Type 6: High grade butyl sealant meeting Federal Specification TT-S-00-1657. BC-158 by Pecora Corporation or approved equal.
 7. Type 7: Multi-component chemical resistant polysulfide sealant conforming to ASTM C-920, Type M, Grade NS, Class 25 such as Sonolastic Two Part by BASF Construction Chemicals, or approved equal.
 8. Type 8: Non-sag, Multi Component, traffic grade polyurethane sealant meeting ASTM C920, Type 19, Grade NS, Class 25, use T, M, A, and O. DynaTread by Pecora Corporation or approved equal.
- C. Joint Backing shall be closed cell foam. Material shall be nonreactive with caulking materials and non-oily. Minimum density shall be 3.24 pcf. Use no asphalt or bitumen-impregnated fiber with sealants.
- D. Joint cleaner shall be as recommended by sealant or caulking compound manufacturer.
- E. Joint Primer shall be as recommended by sealant manufacturer.
- F. Bond Breaker tape shall be either polyethylene or plastic as recommended by the sealant manufacturer.
- G. Color: Where manufacturer's standard colors do not closely match materials being sealed, provide a custom color.

PART 3 - EXECUTION

3.01 GENERAL

- A. Comply with sealant manufacturer's printed instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

3.02 SHIPPING, HANDLING AND STORAGE

- A. Store and handle materials so as to prevent the inclusion of foreign matter or the damage of materials by water or breakage. Procure and store in original containers until ready for use. Material showing evidence of damage will be rejected.
- B. Store and handle materials so as to prevent the inclusion of foreign matter or the damage of materials by water or breakage. Procure and store in original containers until ready for use. Material showing evidence of damage shall be rejected.

3.03 INSTALLATION

- A. Employ only proven installation techniques, which will insure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surface equally on opposite sides. Except as otherwise indicated, the Contractor shall fill the sealant rabbet to a concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.
- B. Install sealants to depths as specified, or if not, as recommended by the sealant manufacturer and as follows:
 - 1. Moving Joints: For normal moving joints sealed with elastomeric sealants but not subject to traffic, fill joints to a depth equal to 50% of joint width, but not more than 1/2-inch deep or less than 1/4-inch deep.
 - 2. Sealed Joints: For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in the range of 75% to 125% of joint width.
 - 3. Thresholds: Set thresholds in full bed of caulking compound; remove excess materials.

3.04 SCHEDULE

A. Schedule of Sealants

Application	Sealant	Color
Vertical and horizontal joints bordered on both sides by concrete, masonry, precast concrete, EIFS, or other porous building material.	Type 2	To closely match adjacent surfaces or mortar and as selected by the City.
Vertical and horizontal joints bordered on both sides by painted metals, anodized aluminum, mill finished aluminum, PVC, glass or other non-porous building material.	Type 3	To closely match adjacent surfaces and as selected by the City.
Masonry expansion and control joints less than 1¼" wide.	Type 2	To closely match adjacent surfaces and as selected by the City.
Masonry expansion and control joints equal or greater than 1¼ inches wide and not to exceed 2".	Type 1	To closely match adjacent surfaces and as selected by the City.

Application	Sealant	Color
Interior – wood trim and finish joints.	Type 5	Color to be selected by City
Sanitary areas, joints in ceramic tile, around plumbing fixtures, countertops, and back splashes. See Note 1.	Type 4	To closely match adjacent surfaces and as selected by the City.
Perimeter sealing of doors, windows, louvers, piping, ducts, and electrical conduit. See Note 2.	Type 2 OR Type 3	To closely match adjacent surfaces and as selected by the City.
Below thresholds.	Type 6	Manufacturer's standard
Submerged in liquids. See Note 4.	Type 1	Manufacturer's standard
Submerged in liquids with high concentration of chlorine (> 2 ppm).	Type 7	Manufacturer's standard
Horizontal Joints exposed to vehicular or pedestrian traffic.	Type 8	To closely match adjacent surfaces.
Other joints indicated on the drawings or customarily sealed but not listed.	Type recommended by manufacturer	To closely match adjacent surfaces and as selected by the City.

Note 1: Sealant for Laboratory Countertop shall be as recommended by countertop manufacturer.
 Note 2: Provide UL approved sealants for penetrations thru fire-rated walls and as specified in Section 07270.
 Note 3: Sealants which will come in contact with potable water shall meet the requirements of NSF 61.
 Note 4: Where sealant will be immersed in liquid chemicals verify compatibility prior to installation of sealant.

3.05 PROTECTION OF ADJOINING SURFACES

- A. Prime or seal the joint surfaces wherever shown or recommended by the sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

3.06 SEALANT BACKER ROD

- A. Install sealant backer rod for liquid elastomeric sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown.

3.07 BOND BREAKER

- A. Install bond breaker tape wherever shown and wherever required by manufacturer's recommendations to insure that elastomeric sealants will perform properly.

3.08 SPILLAGE

- A. Sealants or compounds shall not overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces. Masking tape or other precautionary devices shall be used to prevent staining of adjoining surfaces.

3.09 CURING

- A. Sealants and caulking compounds shall be cured in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength, and surface durability.

3.10 CLEANING

- A. Excess and spillage of compounds shall be promptly removed as the work progresses. Adjoining surfaces shall be cleaned by whatever means may be necessary to eliminate evidence of spillage. Do not damage the adjoining surfaces or finishes.

END OF SECTION

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SECTION 08120

ALUMINUM DOORS AND DOOR FRAMES

PART 1 - GENERAL

1.01 THE REQUIREMENTS

- A. The Contractor shall furnish and install all flush aluminum doors, aluminum frames, and related items, complete and operable, including all finish hardware and appurtenant work, all in accordance with the requirements of the Contract Documents.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 07920 - Sealants and Caulking
- B. Section 08710 - Finish Hardware

1.03 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of the Florida Building Code and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of this Section.
- B. Products and their installation shall be in accordance with the following trade standards as applicable.
 - 1. Aluminum Association System AA M21C22A42 and AA M21C22A41.
 - 2. Architectural Aluminum Manufacturers Association (AAMA) Specifications 2GD A2HP.
 - 3. National Association of Architectural Metal Manufacturers (NAAMM).
 - 4. Manufacturer's published recommendations and Specifications.
 - 5. Flamespread shall conform to ASTM E 84 (HPMA Test T 1113).
 - 6. Sealants shall conform to TT S 001 657, ASTM C 834, TT S 001 543A.

1.04 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with the requirements of Section 01300 entitled "Submittals."
- B. The submittal shall include the following:
 - 1. Product cut sheets for frames, anchors, door panels and all finish hardware.
 - 2. A complete schedule indicating the masonry openings versus the proposed doors, door frames, window frames and the associated door hardware. Prior to the submittal, all openings shall be field-verified by the Contractor.

3. A complete hardware schedule conforming to Section 08710 entitled "Finish Hardware", in compliance with Product Approval.
 4. Installation details, edge distances, material, size, and spacing of anchorage.
 5. Locking arrangement.
 6. Sealants.
 7. Types, finishes and locations of door louvers with construction details.
 8. Window construction details and assembly methods, including glass types.
 9. Florida Product Approval for use in the High Velocity Hurricane Zone.
- C. The Engineer will review and return the submittals to the Contractor. The Contractor shall then submit the accepted package to the Building Departments having jurisdiction over the work for approval. No fabrication or installation shall begin until the Building Department approval is obtained by the Contractor. All permit fees shall be paid for by the Contractor and included in the bid price. The City will not assume responsibility for any cost or schedule impacts due to the approval process of the Building Department. It is the Contractor's responsibility to customize the submittals based on the Building Department's published submittal processes.

1.05 PRODUCT APPROVAL NOTICES

- A. A prototype of all products supplied under this section shall have a Product Approval Notice. A copy of the notices with all drawings shall be submitted for review. The notice shall indicate that the following tests were conducted on the prototype for small missile impact and large missile impact:
1. Impact Test – Florida Building Code Test Protocols TAS 201, Impact Test Procedure (Large and Small Missile).
 2. Uniform Static Pressure Test - Florida Building Code Test Protocols TAS 202, Criteria for Testing Impact and Non-Impact Resistant Building Envelope Components using Uniform Static Air Pressure.
 3. Cyclic Wind Pressure Test - Florida Building Code Test Protocols TAS 203. Criteria for testing products subject to Cyclic Wind Pressure Loading.

1.06 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall deliver, store, and handle doors, windows and frames in a manner to prevent damage and deformation. Store on pallets at the job site and undercover to form weather tight enclosure. Spacers shall be provided between doors and frames to prevent metal-to-metal contact.

PART 2 - PRODUCTS

2.01 FLUSH ALUMINUM DOORS

- A. Flush aluminum doors shall be as manufactured by Cline Aluminum Doors, Alutech Corporation or equal. All doors shall be products of a single manufacturer.
- B. Doors shall be completely flush in design constructed with tubular aluminum jamb rails and tubular aluminum grid sections with face sheets.
- C. Doors shall have an internal frame system comprised of 1 1/2 inch x 4 inch (minimum) tubular sections. All internal members shall be anodized.
- D. All voids between sub-frames shall be filled with a core laminated between face sheets as required by the door manufacturer to meet the requirements of the Florida Product Approval.
- E. All doors shall be completely reinforced for the specified hardware. The reinforcements shall be aluminum alloy 6061 T6 and shall not be less than 0.125 inches thick.
- F. The minimum thickness of door components shall be as follows:
 - 1. Face sheet 0.040 inches
 - 2. Beveled lock rail edge 0.125 inches
 - 3. Hinge rail edge 0.125 inches
 - 4. Internal grid sections 0.080 inches
- G. Doors shall be provided with a finish specified on the drawings.
- H. Entry door weatherstripping required at jambs, head, and bottom sweep strip shall be metal backed, pile cloth.
- I. All screws shall be stainless steel. Exposed screws shall be heat treated, stainless steel of color to match the aluminum finish.

2.02 ALUMINUM DOOR FRAMES

- A. Aluminum frames shall be extruded from 6063-T5 or 6063-T6 aluminum alloy, and shall have a minimum wall thickness of 0.125 inch. Door frames shall be provided with an anodized finish.
- B. All frame jamb, header and mullion joints shall be accurately milled to hairline cracks. All corners shall be mechanically joined with an interlocking aluminum channel clip and flat head stainless steel screws.
- C. All frames shall be adequately reinforced to receive the hardware. Reinforcements shall be 6061-T6 aluminum and shall not be less than 0.1875-inch thick.
- D. Frames shall be drilled and tapped for field installation of hardware.

- E. Frames shall be constructed in accordance with Governmental Specifications CS-230-60.

2.03 ANCHORS

- A. For cast-in-place concrete, anchor frame jambs with ¼-inch minimum concrete screws spaced in accordance with Product Approval.

PART 3 - EXECUTION

3.01 GENERAL

- A. Workmanship and installation shall be in accordance with referenced standards. Field dimensions, conditions, and coordination with adjoining work shall be verified prior to fabrication.
- B. All framing materials shall be screwed in place using backing, anchor plugs, or straps are required.
- C. Where moldings are jointed, they shall be accurately cut and fit to result in a tightly closed joint.

3.02 SHIPPING, HANDLING AND STORAGE

- A. The Contractor shall deliver, store and handle doors and frames to avoid damage from impact, abrasion, and moisture. He shall store doors in a space having controlled humidity, and shall not proceed with installation until temperature and humidity approximate that of the occupied structure.
- B. Each door shall be marked with a stamp, brand or label which identifies the manufacturer.

3.03 FRAME INSTALLATION

- A. Frames shall be installed plumb, level and true to line, rigidly secured in openings. Frames in masonry walls shall be set prior to beginning masonry work. Frames shall be filled with cement grout as masonry work progresses. Anchors shall be provided as previously specified.

3.04 DOOR INSTALLATION

- A. Doors shall be installed plumb, level and true to line. Hardware shall be applied and adjusted to achieve quiet and smooth operation. Installation shall be in accordance with the manufacturer's recommendations.
- B. Doors shall fit snugly and close without forcing or binding. Door clearance shall not exceed 1/8 inch at jambs and heads and meeting stiles at pairs of doors. Clearance between bottom of door and finished floor material or threshold shall not exceed 1/4 inch. Frames shall be manufactured and machined to within 1/32 inch for all dimensions.

3.05 PROTECTION

- A. Aluminum to be placed adjacent to masonry or dissimilar metals shall be protected with an isolating coating of bitumastic and/or felt.
- B. Finished installation shall be protected until time of final acceptance. Damaged doors and frames shall be repaired or replaced at no additional cost to the City.

3.06 GUARANTEE

- A. The Door and Window manufacturers shall guarantee the workmanship and material on the doors and windows including hardware for a minimum period of three years.

END OF SECTION

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SECTION 08525
ALUMINUM WINDOWS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Aluminum windows.

B. Related Sections include but are not necessarily limited to:

1. Section 07900 - Joint Sealants.
2. Section 08800 - Glass and Glazing.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Architectural Manufacturers Association (AAMA):
 - a. 904, Voluntary Specification for Multi-Bar Hinges in Window Applications
 - b. 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - c. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
2. ASTM International (ASTM):
 - a. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - b. C1363, Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
 - c. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - d. E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.
 - e. E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
3. American Welding Society (AWS):
 - a. D1.2, Structural Welding Code - Aluminum.

1.03 DEFINITIONS

A. Installer or Applicator:

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

1.04 SUBMITTALS

A. Shop Drawings:

1. Product technical data for framing system and major accessories including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Hardware being provided by window manufacturer.
 - c. Glass being provided by window manufacturer in factory glazed units.
 - d. Manufacturer's installation instructions.
2. Elevation drawings indicating window dimensions and details.

B. Samples:

1. After initial color selection, provide 2 x 3 inches minimum sample of each color and finish selected.

C. Informational Submittals:

1. Qualifications of testing laboratory.
2. Test results.
3. Warranty.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store units in vertical position off ground with wood spacers between each unit.

1.06 WARRANTY

A. Five year warranty of weathertightness of installation.

1. Air and water integrity and structural adequacy of units and hardware, including sealants and sealing within and around perimeter of installation.
2. Signed jointly by fabricator, installer, and contractor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Thermally broken windows:
 - a. Wausau Metals Corp., 2250-T Series.
 - b. Kawneer Company Inc., 8225-T Series.
 - c. EFCO Windows, Series 510.

2.02 MATERIALS

- A. Extruded Aluminum: 6063T5 alloy.
- B. Sealants: As specified in Section 07900.
- C. Thermal Insulator: Poured in place polyurethane, self-adhering to adjacent aluminum surfaces.
- D. Weatherstripping: Sponge neoprene.

2.03 ACCESSORIES

- A. Flashing:
 - 1. Minimum 0.040 inches aluminum.
 - 2. Finish to match window frames.
 - 3. Mill finish if concealed.

2.04 FABRICATION

- A. General:
 - 1. Fully degrease and clean members prior to assembly or application of protective coatings.
 - 2. Weld by methods recommended by manufacturer and AWS D1.2 to avoid discoloration at welds.
 - 3. Grind exposed welds smooth and restore finish.
 - 4. Ease corners of cut edges to a radius of approximately 1/64 inches.
 - 5. Conceal fasteners wherever possible.
 - 6. Fit and assemble work at shop to maximum extent possible.
 - 7. Maintain true continuity of line and accurate relation of planes and angles.

8. Provide secure attachment and support at mechanical joint, with hairline fit of contacting members.
 9. Reinforce work as necessary to withstand wind loadings and to support system.
 10. Separate dissimilar metal with paint or preformed separators to prevent corrosion.
 - a. See Section 09961.
 11. Separate metal surfaces at moving joints with plastic inserts or other nonabrasive concealed inserts to permanently prevent freeze-up of joint.
 12. Reinforce frames for hardware.
 13. Structural steel reinforcement hot-dip galvanized after fabrication meeting G-90, ASTM A924, requirements.
- B. Thermal Insulator: Provide minimum 1/4 inches separation between exterior and interior metal surfaces after bridge is removed.
- C. Weatherstripping:
1. Thermally broken type windows:
 - a. Casement and projected:
 - 1) Provide two rows of fin type extruded neoprene weatherstrips extending around perimeter of sash at both inner and outer overlap contacts.
 - 2) Provide corners which are securely staked and joined.
 - 3) Provide units which are easily replaceable.
- D. Fasteners:
1. Finish exposed fasteners to match finish of system.
 2. Provide Phillips flat head screws where exposed.
- E. Finish: AAMA 2605 Fluoropolymer paint; color to be selected from full range of manufacturer colors.

2.05 SOURCE QUALITY CONTROL

- A. General Test Requirements:
1. Utilize independent testing laboratories specifically qualified to conduct all performance tests required.
 2. Performance tests may be conducted in manufacturer's laboratories provided they are witnessed and certified by qualified independent testing laboratory personnel.
 3. Perform all tests on "Test Unit":

- a. Full-sized window unit for project or a minimum 5 x 8 feet unit mounted in test chamber in exact accordance with job conditions including anchorage system, sealing, etc.
 - b. Test unit to be completely assembled and glazed.
 - 1) Thermal tests may be conducted on 4 x 6 feet unit.
 4. Test air infiltration first, water resistance second.
 - a. Other tests may be in any order.
 5. Test data on vertical pivot windows will be accepted for fixed windows for condensation resistance, thermal, temperature exposure and acoustical tests provided the fixed windows are the same as the vertical windows tested in the following respects:
 - a. Same frame section (or same family of extrusions).
 - b. Same basic metal mass inside and outside.
 - c. Identical thermal break.
 - d. Same type of glazing.
- B. Test Requirements:
1. Air infiltration test:
 - a. With sash and ventilators closed and locked, test in accordance with ASTM E283.
 - b. Air infiltration, in CFM/FT of crack length, at pressure differential of 6.24 psf as follows:
 - 1) Fixed windows: 0.06 maximum, all others 0.10 maximum.
 2. Water resistance test:
 - a. Mount glazed unit in its vertical position, continuously supported around outside perimeter with sash and ventilators closed and locked.
 - b. Test in accordance with ASTM E331.
 - c. No uncontrolled leakage allowed, with pressure differential of 6.24 psf.
 3. Uniform load deflection test:
 - a. Test in accordance with ASTM E330.
 - b. Subject unit to load of 25 psf applied to outside of window and 25 psf applied to inside of window.
 - c. Maximum allowable deflection of any unsupported span: $L/175$.

- d. No glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms, or any other damage which would cause window to be inoperable will be allowed.
4. Uniform load structural test:
- a. Test in accord with ASTM E330.
 - b. Subject unit to loads indicated below.
 - c. Stabilize pressure and maintain it for minimum period of 10 seconds.
 - d. No glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms or any other damage which would cause window to be inoperable will be allowed.
 - e. Maximum permanent deformation of any main frame, sash or ventilator member: 0.4% of its span.
 - f. After performing Uniform Load Structural Test, increase loads 1-1/2 times and perform safety test.
 - g. Design unit to withstand following design pressures acting normal to plane of wall, per location and required building codes.
5. Condensation resistance test:
- a. Perform on "test unit," except size may be 3 x 4 feet, minimum.
 - b. Test in accordance with AAMA 1503.
 - c. CRF (Condensation Resistance Factor): 50, minimum.
6. Structural thermal barrier tension test:
- a. Test urethane filled sections of aluminum.
 - b. Mechanically secure interior and exterior faces of 12 inches section in horizontal position.
 - c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
 - d. Apply direct tension (pull) using a Universal testing machine set in 12,000 pound load range.
 - e. Test results: No loss of bond at 4000 pound IN/IN/MIN.
7. Structural thermal barrier shear test:
- a. Test urethane filled sections of aluminum.
 - b. Mechanically secure interior face of 12 inches section in vertical position.

- c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
 - d. Apply load to exterior face by a bearing plate resting on top of exterior face, using Universal Testing machine set in 12,000 pound load range at a strain rate of 0.050 inches/IN/MIN.
 - e. Test results: No loss of bond at 5500 pound loading.
8. Structural thermal barrier combined torsion and shear test:
- a. Test urethane filled sections of aluminum.
 - b. Secure interior face of 12 inches section in horizontal position.
 - c. Apply heat tape to exterior face to control surface temperature at 180 degrees F 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
 - d. Apply load to bearing plate centered on portion of glazing pocket to exterior side of thermal barrier, using a Universal Testing machine set in the 12,000 pound load range.
 - e. Test results: No loss of bond at 3900 pound load applied at strain rate of 0.05 inches/IN/MIN.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Set units plumb, level, and true to line.
- C. Anchor securely in place.
- D. Separate metal surfaces from sources of corrosion or electrolytic action.
 - 1. See Section 09961.
- E. Set sill and base members in a bed of sealant.
- F. Provide joint fillers or gaskets for weathertight construction.
- G. Seal all joints within and at perimeter of system.
- H. Provide sealant color to match finish of system at exposed locations.
- I. Provide sealants compatible with aluminum system and recommended for use with this type of installation.
- J. See Section 07900 for sealants.

3.02 FIELD QUALITY CONTROL

- A. Installation supervised or inspected by manufacturer's authorized representative.

END OF SECTION

SECTION 08710
FINISH HARDWARE

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish and install items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are to be installed.
- B. This Section includes the following:
 - 1. Hinges.
 - 2. Key control systems.
 - 3. Lock cylinders and keys.
 - 4. Lock and latch sets.
 - 5. Bolts.
 - 6. Exit devices.
 - 7. Closers.
 - 8. Overhead holders.
 - 9. Miscellaneous door control devices.
 - 10. Door trim units.
 - 11. Protection plates.
 - 12. Weatherstripping for exterior doors.
 - 13. Astragals or meeting seals on pairs of doors.
 - 14. Thresholds.

1.02 SUBMITTALS

- A. General: Submit the following in accordance with Section 01300 entitled "Submittals":
 - 1. Product data including manufacturer's 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. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

- a. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - 1) Type, style, function, size, and finish of each hardware item.
 - 2) Name and manufacturer of each item.
 - 3) Fastenings and other pertinent information.
 - 4) Location of each hardware set cross referenced to indications on Drawings, both on floor plans and in door and frame schedule.
 - 5) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 6) Door and frame sizes and materials.
 - 7) Keying information.
 - b. Submittal Sequence: Submit final schedule at earliest possible date, particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.
 - c. Keying Schedule: Submit separate detailed schedule indicating clearly how the City's final instructions on keying of locks has been fulfilled.
3. If requested by architect, submit samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule.
 - a. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.
 4. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.03 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer. All door locks shall be keyed to a keying schedule developed by the City and manufacturer.
- B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware

consultant (AHC) who is available to City, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Require supplier to meet with City to finalize keying requirements and to obtain final instructions in writing.
 2. Supplier shall be an authorized factory distributor of all specified products.
- C. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

1.04 PRODUCT HANDLING

- A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Packaging of door hardware is responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- C. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- D. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).
- E. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.05 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for City's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Butts and Hinges:
 - a. Hager Hinge Co.

- b. McKinney Products Co.
 - c. Stanley Hardware, Div. Stanley Works.
2. Cylinders and Locks:
- a. Sargent Manufacturing Company.
 - b. Schlage Lock, Div. Ingersoll-Rand Door Hardware Group.
3. Exit/Panic Devices:
- a. Sargent Manufacturing Company.
 - b. Von Duprin, Div. Ingersoll-Rand Door Hardware Group.
4. Overhead Closers:
- a. LCN, Div. Ingersoll-Rand Door Hardware Group.
 - b. Sargent Manufacturing Company.
5. Bolts:
- a. H.B. Ives, A Harrow Company.
 - b. Quality Hardware Mfg. Co., Inc.
 - c. Rockwood Mfg. Co.
6. Door Trim Units:
- a. H.B. Ives, A Harrow Company.
 - b. Quality Hardware Mfg. Co., Inc.
 - c. Rockwood Mfg. Co.
7. Kick Plates:
- a. Rockwood Mfg. Co.
 - b. H.B. Ives, A Harrow Company.
 - c. Quality Hardware Mfg Co., Inc.
8. Key Control System:
- a. Key Control Systems, Inc.
 - b. Telkee Inc.
9. Thresholds, Door Stripping and Seals, Automatic Drop Seals, Astragals:
- a. National Guard Products, Inc.
 - b. Pemko Manufacturing Co., Inc.

c. Reese Enterprises, Inc.

2.02 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the "Hardware Schedule" at the end of this Section. Products are identified by using hardware designation numbers of the following:
1. Manufacturer's Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Provide either the product designated or, where more than one manufacturer is specified under the Article "Manufacturers" in Part 2 for each hardware type, the comparable product of one of the other manufacturers that complies with requirements.
 2. ANSI/BHMA designations used elsewhere in this Section or in schedules to describe hardware items or to define quality or function are derived from the following standards. Provide products complying with these standards and requirements specified elsewhere in this Section.
 - a. Butts and Hinges: ANSI/BHMA A156.1.
 - b. Bored and Preassembled Locks and Latches: ANSI/BHMA A156.2.
 - c. Exit Devices: ANSI/BHMA A156.3.
 - d. Door Controls - Closers: ANSI/BHMA A156.4.
 - e. Auxiliary Locks and Associated Products: ANSI/BHMA A156.5.
 - f. Architectural Door Trim: ANSI/BHMA A156.6.
 - g. Template Hinge Dimensions: ANSI/BHMA A156.7.
 - h. Door Controls - Overhead Holders: ANSI/BHMA A156.8.
 - i. Interconnected Locks and Latches: ANSI/BHMA A156.12.
 - j. Mortise Locks and Latches: ANSI/BHMA A156.13.
 - k. Closer Holder Release Devices: ANSI/BHMA A156.15.
 - l. Auxiliary Hardware: ANSI/BHMA A156.16.
 - m. Materials and Finishes: ANSI/BHMA A156.18.

2.03 MATERIALS AND FABRICATION

- A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.
- B. Manufacturer's identification will be permitted on rim of lock cylinders only.

- C. Base Metals: Produce hardware units of basic metal and forming method indicated using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units for finish designations indicated.
- D. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
- E. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
- F. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use hex screw fasteners.

2.04 HINGES, BUTTS, AND PIVOTS

- A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- B. Screws: Provide Phillips flat-head screws complying with the following requirements:
 - 1. For metal doors and frames install machine screws into drilled and tapped holes.
 - 2. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - 1. Out-Swing Exterior Doors: Nonremovable pins.
 - 2. Interior Doors: Nonrising pins.
 - 3. Tips: Flat button and matching plug, finished to match leaves, except where hospital tip (HT) is indicated.
- D. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90 inches or less in height and one additional hinge for each 30 inches of additional height.
 - 1. Fire-Rated Doors: Not less than 3 hinges per door leaf for doors 86 inches or less in height with same rule for additional hinges.

2.05 LOCK CYLINDERS AND KEYING

- A. Review the keying system with the City and provide the type required (master, grandmaster or great-grandmaster), either new or integrated with City's existing system.

- B. Equip locks with manufacturer's special 6-pin tumbler cylinder with construction masterkey feature that permits voiding of construction keys without cylinder removal.
- C. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
- D. Comply with City's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
- E. Key Material: Provide keys of nickel silver only.
- F. Key Quantity: Furnish 2 change keys for each lock, 5 master keys for each master system, and 5 grand masterkeys for each grandmaster system.
 - 1. Deliver keys to City.

2.06 KEY CONTROL SYSTEM

- A. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of locks required for the Project.
 - 1. Provide hinged-panel type cabinet for wall mounting.

2.07 LOCKS, LATCHES, AND BOLTS

- A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.
 - 1. Provide flat lip strikes for locks with 3-piece, antifriction latchbolts as recommended by manufacturer.
 - 2. Provide recess type top strikes for bolts locking into frame heads, unless otherwise indicated.
 - 3. Provide roller type strikes where recommended by manufacturer of the latch and lock units.
- B. Lock Throw: Provide 5/8-inch minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
 - 1. Provide 1/2-inch minimum throw of latch for other bored and preassembled types of locks and 3/4-inch minimum throw of latch for mortise locks. Provide 1-inch minimum throw for all dead bolts.
- C. Flush Bolt Heads: Minimum of 1/2-inch-diameter rods of brass, bronze, or stainless steel with minimum 12-inch-long rod for doors up to 7'-0" in height. Provide longer rods as necessary for doors exceeding 7'-0" in height.

2.08 CLOSERS AND DOOR CONTROL DEVICES

- A. All closers shall be constructed with rack and pinion with compression springs. The Closing speed, latching speed and backcheck shall be controlled by key operated valves. The delay action feature shall be a separate key operated valve. The closer body shall be manufactured of high performance cast aluminum silicon alloy. All door closers shall be suitable for standard, top jamb, track, corner bracket and parallel arm applications when provided with proper brackets and arms. The closer should be adjustable to meet the range of sizes required for opening and closing forces.
- B. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.

2.09 DOOR TRIM UNITS

- A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.

2.10 WEATHERSTRIPPING AND SEALS

- A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.11 THRESHOLDS

- A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

2.12 HARDWARE FINISHES

- A. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes.
 - 1. Stainless steel, US32D unless otherwise noted.
 - 2. Closers shall have a USP finish unless otherwise noted.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as specifically indicated or required to comply with governing regulations:
 - 1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work

specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

- C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.
- F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.02 ADJUSTING, CLEANING, AND DEMONSTRATING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
 - 1. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Instruct City's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.
- D. Six-Month Adjustment: Approximately six months after the date of Substantial Completion, the Installer, accompanied by representatives of the manufacturers of latchsets and locksets and of door control devices, and of other major hardware suppliers, shall return to the Project to perform the following work:
 - 1. Examine and re-adjust each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.
 - 2. Consult with and instruct City's personnel in recommended additions to the maintenance procedures.

3.03 HARDWARE SCHEDULE

- A. General: Provide hardware for each door to comply with requirements of this Section, hardware set numbers indicated in the door schedule on the Drawings, and in the following schedule of hardware sets.

Hardware Set No. 1 – Single Leaf Exit Door

3 EA ¹	Hinge	McKinney	T4A3386	4.5 x 4.5 NRP	32 D
1 EA	Exit Device	Sargent	HC8813ETJ		32 D

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1 EA	Closer	Dorma	P640 STA TB	AL
1 EA	Threshold	Pemko	2005AS	AL
1 EA	Jamb Seal	Pemko	S88D	AL
1 EA	Lock	Sargent	8215 LNJ	32 D

¹Use 4 Nos. for doors greater than 7'-0" high

Hardware Set No. 2 – Double Leaf Exit Door

6 EA ¹	Hinge	McKinney	T4A3386	4.5 x 4.5 NRP	32 D
1 EA	Exit Device	Sargent	HC8813 ETJ		32 D
1 EA	Lock	Sargent	8205 LNJ		32 D
2 EA	Stops	Rockwood	460		26 D
1 EA	Threshold	Pemko	2005 AS		AL
1 EA	Jamb Seal	Pemko	303 AS		AL
2 EA	Kickplate	Quality	48		SS
1 EA	Surface Bolts	Ives	360-12		F2C

¹Use 8 Nos. for doors greater than 7'-0" high

END OF SECTION

SECTION 08800
GLASS AND GLAZING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Glass and glazing.
2. Fire resistance rated glass.

B. Related Specification Sections include but are not necessarily limited to:

1. Section 07900 - Joint Sealants.
2. Section 08120 - Aluminum Doors and Frames.
3. Section 08525 – Aluminum Windows.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American National Standards Institute (ANSI):
 - a. Z97.1, Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
2. ASTM International (ASTM):
 - a. C864, Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - b. C1036, Standard Specification for Flat Glass.
 - c. C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
 - d. C1376, Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 - e. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
 - f. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.
3. Code of Federal Regulations (CFR):

- a. Title 16 - Commercial Practices, Chapter ii - Consumer Product Safety Commission (CPSC), Subchapter B - Consumer Product Safety Act Regulations:
 - 1) 16 CFR 1201, Safety Standard for Architectural Glazing Materials.
- 4. Glass Association of North America (GANA):
 - a. Glazing Manual.
- 5. Insulating Glass Certification Council (IGCC).
- 6. Insulating Glass Manufacturers Alliance (IGMA):
 - a. TM-3000, North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.
- 7. National Fire Protection Association (NFPA).
 - a. 80, Standard for Fire Doors and Other Opening Protectives.
 - b. 251, Standard Methods of Tests of Fire Resistance of Building Construction and Materials.
 - c. 252, Standard Methods of Fire Tests of Door Assemblies.
 - d. 257, Standard on Fire Test for Window and Glass Block Assemblies.
- 8. Underwriters Laboratories, Inc. (UL):
 - a. 9, Standard for Fire Tests of Window Assemblies.
 - b. 10B, Standard for Fire Tests of Door Assemblies.
 - c. 263, Standard for Fire Tests of Building Construction and Materials.

1.03 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- B. Safety Glazing: Glazing meeting the requirements of the building code and CPSC 16 CFR 1201.
- C. Other terms as identified in CPSC 16 CFR 1201.

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Product technical data including:

- a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Certification that glass has been tested and approved for use in fire resistance rated doors or walls.
 - 1) Copies of all test criteria.
2. Certification that insulating glass units meet requirements of IGCC and are certified by IGCC to ASTM E2190.
- B. Samples:
1. Two, 12 x 12 inches sample of each type, color, and thickness specified.
 - a. Samples are not required for clear monolithic glass.
- C. Informational Submittals:
1. Warranty.

1.05 WARRANTY

- A. Provide manufacturer's written 10 year warranty to cover deterioration of glass, glass units, coatings and ceramic frit.
1. Insulating glass units shall be warranted against failure of hermetic seal resulting in fogging or film formation on the interior glass surfaces.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Glass:
 - a. Guardian Glass by Guardian Industries.
 - b. Insulite Glass Co., Inc.
 - c. NSG/Pilkington.
 - d. Oldcastle Building Envelope.
 - e. Vitro Architectural Glass.
 - f. Viracon.
 2. Gaskets, glazing compounds, setting blocks, spacers, sealant, sealant tape, etc., as recommended by glass manufacturer, glass unit fabricator.

- a. Provide materials as required by NFPA for use in fire-rated units.

2.02 MATERIALS

A. General:

1. ASTM C1036.
 - a. Clear glass: Type I, Class 1, Quality Q3.
 - b. Tinted glass: Type I, Class 2, Quality Q3.
2. Thickness: 1/4 inches, unless noted otherwise.

B. Heat Strengthened and Fully Tempered Glass: ASTM C1048.

1. General use: Kind HS.
2. Safety glazing: Kind FT.
 - a. Meet requirements of ANSI Z97.1 and CSPC 16 CFR 1201.
3. Condition:
 - a. Clear or tinted vision glass: Condition A.
 - b. Spandrel Glass (ceramic coated): Condition B.
 - c. Coated vision glass: Condition C.
 - 1) ASTM C1376, Kind CV or CO.

2.03 MANUFACTURED UNITS

A. Laminated Safety Glass:

1. ASTM C1172, Type II.
 - a. Meet requirements of ANSI Z97.1 and CSPC 16 CFR 1201.
2. Interlayer: Clear plastic manufactured specifically for use in laminated glass.
 - a. Polyvinyl Butyral (PVB): 0.060 inches thick.
 - b. Enhanced Polyvinyl Butyral (EPVB): 0.100 inches thick.
 - 1) Viracon "StormGuard".

2.04 ACCESSORIES

A. Glazing Compounds:

1. Non-sag, non-stain type.
2. Pigmented to match frame units not requiring painting.
3. Compatible with adjacent surfaces.

4. One- or two-part polyurethane or silicone sealant for use in setting glass.
 - a. Provide glazing compounds which will not be affected by chemicals stored in rooms where glazing compounds are used.
- B. Sealant Tape: Butyl rubber sealant tape or ribbon having a continuous neoprene shim.
- C. Gaskets:
 1. Flexible polyvinyl chloride or neoprene.
 - a. ASTM C864.
 - b. Provide gaskets which will not be affected by chemicals stored in rooms where gaskets are used.
 2. Extruded of profile and hardness required to receive glass and provide a watertight installation.
 3. Provide gaskets in accordance with NFPA in fire resistance rated glazing.
- D. Setting Blocks and Spacers:
 1. Neoprene or EPDM, compatible with sealants used.
 - a. ASTM C864.
- E. Compressible Filler Stock: Closed cell polyethylene or polyethylene jacketed polyurethane foam.
- F. Shims, Clips, Screws and Other Miscellaneous Items: As required by condition.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with recommendations of manufacturer, GANA Glazing Manual and IGMA TM-3000.
- B. Install setting blocks in adhesive or sealant.
- C. Install spacers inside and out, of proper size and spacing, for all glass sizes larger than 50 united inches, except where gaskets are used for glazing.
- D. Provide 1/8 inches minimum bite of spacers on glass.
- E. Spacer thickness to equal sealant width.
- F. Prevent sealant exudation from glazing channels of insulating glass which is more than 1/2 inches thick; colored, heat absorbing, coated or laminated glass sizes larger than 75 united inches; and other glass more than 9/32 inches thick or larger than 125 united inches.
 1. Leave void at heel (or install filler) at jambs and head.

2. Do not leave void (or install filler) at sill.
- G. Miter cut and bond gasket ends together at corners.
- H. Immediately after installation, attach crossed streamers to framing held away from glass.
- I. Use polysulfide-based glazing sealants in window assembly and as perimeter sealant around frames in areas which may be exposed to chlorine gas or chlorine liquid splash or spillage.
 1. See Specification Section 07900 for sealants.
- J. Install fire resistance rated glass in accordance with manufacturer's recommendations and in accordance with applicable fire testing criteria.

3.02 FIELD QUALITY CONTROL

- A. Do not install glass with edge damage.
- B. Do not apply anything to surfaces of glass.
- C. Remove and replace damaged glass.

3.03 CLEANING

- A. Maintain glass reasonably clean during construction, so that it will not be damaged by corrosive action and will not contribute to deterioration of other materials.
- B. Wash and polish glass on both faces not more than seven days prior to acceptance of work in each area.
 1. Comply with glass manufacturer's recommendations.

3.04 SCHEDULES

- A. General:
 1. Provide safety glazing for all applications where required by the building code and CPSC 16 CFR 1201.
 2. Provide heat strengthened glazing for all general use applications where safety glazing is not required.
- B. Glass Type 1: Insulating Low-E Laminated Glass Units.
 1. Exterior lite: 1/4 inches with Viracon VE-2M on #2 surface.
 - a. Color: __Gray__
 2. 1/2 inches dehydrated air space.
 3. Interior lite: Laminated Glass.
 - a. Exterior ply: 1/4 inches clear.

- b. Interlayer: See MANUFACTURED UNITS Article in PART 2.
- c. Interior ply: 1/4 inches clear.
- 4. Performance Requirements:
 - a. Transmittance:
 - 1) Visible light: __33__%.
 - 2) Solar energy: __15__%.
 - 3) UV: __< 1__%.
 - b. Reflectance:
 - 1) Exterior: __6__%.
 - 2) Interior: __9__%.
 - 3) Solar: __12__%.
 - c. U-Value
 - 1) Winter: __.29__.
 - 2) Summer: __.26__.
 - d. Shading Coefficient: __.27__.
 - e. Relative Heat Gain: __58__.
 - f. Solar Heat Gain Coefficient (SHGC): __.24__.
- C. Glass Type 2: Insulating Low-E Laminated Glass Units with opaque film.
 - 1. Exterior lite: 1/4 inches with Viracon VE-2M on #2 surface.
 - a. Color: __Gray__
 - 2. 1/2 inches dehydrated air space.
 - 3. Interior lite: Laminated Glass.
 - a. Exterior ply: 1/4 inches clear.
 - b. Interlayer: See MANUFACTURED UNITS Article in PART 2.
 - c. Interior ply: 1/4 inches clear with opaque film on #6 surface.
 - 4. Performance Requirements:
 - a. Transmittance:
 - 1) Visible light: __33__%.
 - 2) Solar energy: __15__%.

- 3) UV: < 1 %.
- b. Reflectance:
 - 1) Exterior: 6 %.
 - 2) Interior: 9 %.
 - 3) Solar: 12 %.
- c. U-Value
 - 1) Winter: $.29$.
 - 2) Summer: $.26$.
- d. Shading Coefficient: $.27$.
- e. Relative Heat Gain: 58 .
- f. Solar Heat Gain Coefficient (SHGC): $.24$.

END OF SECTION

SECTION 09220

SENERGY PLATINUM CI STUCCO ULTRA SYSTEM

Specification for 2 and 3 coat impact-resistant continuously insulated (CI) premium cement plaster stucco system featuring a rain screen design with enhanced water management

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Refer to all project drawings and other sections of this specification to determine the type and extent of work therein affecting the work of this section, whether such work is specifically mentioned herein.
- B. Platinum CI Stucco Wall System: Composite insulated stucco wall system consisting of air/water-resistive barrier, drainage mat, rigid insulation, plaster base, stucco base, base coat(optional), reinforcing mesh (optional), primer (optional) and finish coat.
- C. Senergy products are listed in this specification to establish a standard of quality. Any substitutions to this specification shall be submitted to and receive approval from the Architect at least 10 days before bidding. Proof of equality shall be borne by the submitter.
- D. The system type shall be Senegy Platinum CI Stucco Ultra wall system as manufactured by Master Builders Solutions, Shakopee, MN.

1.02 REFERENCES

- A. ASTM C150 Standard Specification for Portland Cement
- B. ASTM C926 Standard Specification for Application of Portland Cement-Based Plaster
- C. ASTM C1063 Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster
- D. ASTM C847 Standard Specification for Metal Lath
- E. ASTM C933 Standard Specification for Welded Wire Lath
- F. ASTM C1032 Standard Specification for Woven Wire Plaster Base
- G. ASTM C1764 Standard Test Methods for Non-Metallic Plaster Bases (Lath) used with Portland Cement Based Plaster in Vertical Applications
- H. ASTM C1787 Standard Specification for Installation of Non-Metallic Plaster Bases (Lath) used with Portland Cement Based Plaster in Vertical Applications
- I. ASTM C1788 Standard Specification for Installation of Non-Metallic Plaster Bases (Lath) used with Portland Cement Based Plaster in Vertical Applications
- J. ASTM D226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

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- K. ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds
- L. ICC-ES AC11 Cementitious Exterior Wall Coatings
- M. CCRR 0230 Intertek Code Compliance Research Report for STUCCOBASE™/ STUCCOBASE™ PREMIX
- N. CCRR 0249 Intertek Code Compliance Research Report (PERMALATH 1000)
- O. ESR-3463 ICC Evaluation Service, LLC, ES Report™ (NEOPOR® Rigid Insulation Board)
- P. ESR-2986 ICC Evaluation Service, Inc., ES Report™ (SENERSHIELD-R/RS)

1.03 SUBMITTALS

- A. Submit under provisions of Division 01
- B. Product Data: Provide data on Senergy Platinum CI Stucco Ultra wall system materials, product characteristics, performance criteria, limitations and durability.
- C. Code Compliance: Provide manufacturer's applicable code compliance report.
- D. Samples: Submit two 6 inch size samples of Senergy Platinum CI Stucco Ultra wall system illustrating Senergy Finish color and texture range.
- E. Certificate: System manufacturer's approval of applicator.
- F. Sealant: Sealant manufacturer's certificate of compliance with ASTM C920.
- G. System manufacturer's current specifications, typical details, system design guide and related product literature which indicate preparation required, storage, installation techniques, jointing requirements and finishing techniques.

1.04 QUALITY ASSURANCE

- A. Manufacturer: More than 10 years in the cement plaster stucco industry, with more than 1000 completed cement plaster stucco projects.
- B. Applicator: Approved by Master Builders Solutions in performing work of this section.
- C. Regulatory Requirements: Conform to applicable code requirements for cement plaster stucco.
- D. Field Samples
 - 1. Provide under provisions of Division 01
 - 2. Construct one field sample panel for each color and texture, 3 ft in size of system materials illustrating method of attachment, Senergy Finish color and texture.
 - 3. Prepare each sample panel using the same tools and techniques to be used for the actual application.
 - 4. Locate sample panel where directed.

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5. Accepted sample panel may remain as part of the work.
6. Field samples shall be comprised of all wall assembly components including substrate, air/water-resistive barrier, drainage mat, rigid insulation, plaster base, stucco base, base coat (if specified), reinforcing mesh (if specified), primer (if specified), finish coat and typical sealant/flashing conditions.

E. Testing

1. General Air/Water-Resistive Barrier Minimum Performance:

TEST	METHOD	CRITERIA	RESULTS
Air Leakage of Air Barrier Assemblies	ASTM E2357	0.2 l/(s.m2) @75 Pa (0.04 cfm/ft2 @ 1.57 psf)	0.0007 l/s.m ² (0.0001 cfm/ft ²) @ 75 Pa (1.57 psf) positive / post conditioning 0.0014 l/s.m ² (0.0003 cfm/ft ²) @ 75 Pa (1.57 psf) negative / post conditioning
Air Permeance of Building Materials	ASTM E2178	0.02 l/(s.m2) @75 Pa (0.004 cfm/ft2 @ 1.57 psf)	0.0049 l/s.m ² @ 75 Pa (0.00098 cfm/ft ² @ 1.57 psf)
Rate of Air Leakage	ASTM E283		0.0185 l/s.m ² @ 75 Pa (0.0037 cfm/ft ² @ 1.57 psf)
Water Vapor Transmission	ASTM E96	Report value	Senersshield-R - 18 Perms (grains/Hr. in Hg. ft ²) @ 10 mils wet film thickness Senersshield-RS - 18 Perms (grains/Hr. in Hg. ft ²) @ 12 mils wet film thickness Senersshield-R/RS - 14 Perms (grains/Hr. in Hg. ft ²) @ 20 mils wet film thickness Senersshield-VB - 0.09 Perms (grains/Hr. in Hg. ft ²) @ 26 mils wet film thickness
Pull-Off Strength of Coatings	ASTM D4541	Min. 110 kPa (15.9 psi) or substrate failure	Pass - Tested over exterior gypsum sheathing, ASTM C1177 glass-mat sheathing, cement board, OSB, plywood; PVC and galvanized flashing
Nail Sealability (without Sheathing Fabric)	ASTM D1970	No water penetration at galvanized roofing nail penetration under 127 mm (5") head of water after 3 days at 4° C (40° F)	Pass
Surface Burning	ASTM E84	Flame Spread < 25 Smoke Development < 450	Meets Class A: Flame spread =15 Smoke developed = 95

2. Air/Water-Resistive Barrier ICC-ES AC-212:

TEST	METHOD	CRITERIA	RESULTS
Sequential Testing: 1. Structural 2. Racking 3. Restrained Environmental Conditioning 4. Water Penetration	1. ASTM E 1233 Procedure A 2. ASTM E 72 3. ICC-ES AC-212 4. ASTM E 331	No cracking at joints or interface of flashing No water penetration after 15 min @ 137 Pa (2.86 psf)	Pass - Tested over OSB and gypsum sheathing No water penetration after 90 min @ 299 Pa (6.24 psf)
Sequential Testing: 1. UV Light Exposure 2. Accelerated Aging 3. Hydrostatic Pressure Test	1. ICC-ES AC-212 2. ICC-ES AC-212 3. AATCC 127-1985	No cracking or bond failure to substrate No water penetration after 21.7 in (550 mm) water for 5 hours	Pass
Freeze-Thaw	ASTM E 2485 (Method B)	No sign of deleterious effects after 10 cycles	Pass - Tested over exterior gypsum sheathing, ASTM C1177 glass-mat sheathing, cement board, OSB, plywood
Water Resistance	ASTM D2247	No deleterious effects after 14 day exposure	Pass - Tested over exterior gypsum sheathing, ASTM C1177 glass-mat sheathing, cement board, OSB, plywood
Tensile Bond	ASTM C 297	Minimum 103 kPa (15 psi)	Pass - Tested over exterior gypsum sheathing, ASTM C1177 glass-mat sheathing, cement board, OSB, plywood, CMU; PVC and galvanized flashing
Tensile Bond (after	ASTM C 297	Minimum 103 kPa (15 psi) avg; no	Pass

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freeze-thaw)		failure after 10 cycles freeze-thaw	
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3. Air/Water-Resistance Barrier ICC-ES AC 148:

TEST	METHOD	CRITERIA	RESULTS
Sequential Testing: 1. UV Light Exposure 2. Accelerated Aging 3. Hydrostatic Pressure Test	1. ICC-ES AC 148 2. ICC-ES AC 148 3. AATCC 127-1985	No cracking or bond failure to substrate No water penetration after 21.7 in (550 mm) water for 5 hours	Pass
Peel Adhesion	ASTM D 3330 Method F	After UV Exposure After Accelerated Aging After Elevated Temperature Exposure After Water Immersion	Pass - tested over ASTM C1177 glass-mat sheathing, OSB, plywood, PVC and uncoated aluminum
Nail Sealability after Thermal Cycling	ASTM D 1970 (Modified), AAMA 711	No water penetration at galvanized roofing nail penetration under 1.2" (31 mm) head of water after 24 hours at 40° F (4° C)	Pass
Tensile Strength after UV Exposure	ASTM D 5034, AAMA 711	Minimum 0.5 N/mm (2.9 lb./in)	Pass
Cold Temperature Pliability	ASTM D 1970, AAMA 711	No cracking after bending around a 1" (25 mm) mandrel after 2 hour exposure to 0° F (-18° C)	Pass
Resistance to Peeling	AAMA 711	No signs of distress or failure after 24 hours of exposure at room temperature, 122° F (50° C), 149° F (65° C), 176° F (80° C)	Pass
Drainage Efficiency	ASTM E2273	90% Minimum	Pass
Transverse Wind-load	ASTM E330	3 5/8" 16 GA steel studs 16" o.c., 1/2" gypsum sheathing, 1 layer ASTM D226 #15 felt, rigid insulation board, Lath, 1/2" stucco base	Average ultimate loads1: -10.8 kPa (-226 PSF) +11.8 kPa (+226 PSF)* *Positive failure could not be reached. All failures in framing
Transverse Wind-load	ASTM E330	2" x 4" wood studs 16" o.c., 7/16" OSB, 1 layer 60-minute grade D paper, rigid insulation board, Lath, 1/2" Stucco Base	Average ultimate loads1: -10.4 kPa (-218 PSF) +10.9 kPa (+228 PSF) All failures in framing
Surface Burning Characteristics	ASTM E84	Flame spread <25 Smoke developed < 450	Pass
Behavior of materials in a vertical tube furnace at 750° C	ASTM E136	Weight loss of the specimen cannot exceed 50%.	Pass
Freeze Thaw	ICC-ES AC11	No deleterious effects after 10 cycles	Pass

4. Platinum CI Stucco Ultra System and Component Performance:

TEST	METHOD	CRITERIA	RESULTS
Drainage Efficiency	ASTM E2273	90% minimum	Flat foam / Drainage Mat / Senergy Air/Water-Resistive Barrier exceeds 90% minimum
Surface Burning	ASTM E84	Flame Spread < 25 Smoke Development < 450	Meets Class A: Flame spread =15 Smoke developed = 95
Behavior of materials in a vertical tube furnace at 750° C	ASTM E136		StuccoBase specimens all met the weight loss criteria for passing the tests
Freeze-thaw resistance	Per ICC-ES acceptance criteria - AC11	10 freeze-thaw cycles with no visible evidence of deterioration when examined under 5X magnification	Pass

5. ASTM E330 Wind-Load

6. NFPA 285 and NFPA 268 Compliant Assemblies:

WALL COMPONENTS	MATERIALS
Base wall system – Use either 1, 2 or 3	1. Concrete wall

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	2. Concrete Masonry wall
Cavity Insulation – Use either 1 or 2	1. None 2. Any noncombustible insulation (faced or unfaced)
Air/water-resistive barrier applied to exterior	Senergy SENERSHIELD-R/RS/VB & DRAINAGEMAT
Exterior insulation – Use either 1, 2, 3, 4 or 5	1. Extruded Polystyrene Foam (XPS) – C578 Type X or Type IV & be Class A per ASTM E84 – maximum thickness – See Note 1 2.
Lath	1. PERMALATH 1000 glass fiber lath 2. Metal lath – either 2.5 lb/yd ² or 3.4 lb/yd ² 3. Wire lath – either 1-1/2 inch, 20-gauge or 1-inch, 17-gauge
Stucco	Stucco Base by Master Builders Solutions - minimum ½-inch thick
Finish Coat	Senergy Wall Systems Finish

NOTE – The potential heat of the foam plastic insulation at the maximum installed thickness must not exceed 4999 Btu/ft² as determined in accordance with NFPA 259.

1.05 DELIVERY, STORAGE AND HANDLING - SENERGY/MASTER BUILDERS SOLUTIONS MATERIAL

- A. Deliver, store and handle products under provisions of Section 01600.
- B. Deliver materials in original unopened packages with manufacturer’s labels intact.
- C. Protect materials during transportation and installation to avoid physical damage.
- D. Store materials in cool, dry place protected from exposure to moisture and freezing. Store at no less than 40°F/4°C (50°F/10°C for AURORA STONE, AURORA TC-100, ALUMINA finish).
- E. Store MAXFLASH at a minimum of 40°F. In cold weather, keep containers at room temperature for at least 24 hours before using.
- F. Store rigid insulation boards flat, in original packaging and protected from direct sunlight and extreme heat.
- G. Store Reinforcing Mesh, SHEATHING FABRIC and WS FLASH flexible flashing in cool, dry place.

1.06 PROJECT/SITE CONDITIONS

- A. Do not apply Master Builders Solutions materials in ambient temperatures below 40°F/4°C (50°F/10°C for AURORA STONE, AURORA TC-100, ALUMINA finish). Provide properly vented, supplementary heat during installation and drying period when temperatures less than 40°F/4°C (50°F/10°C for AURORA STONE, AURORA TC-100, ALUMINA finish) prevail.
- B. Do not apply to frozen surfaces.
- C. Maintain ambient temperature at or above 40°F/4°C (50°F/10°C for AURORA STONE, AURORA TC-100, ALUMINA finish) during and at least 24 hours after Senergy Platinum CI Stucco Ultra wall system installation and until dry.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate and schedule installation of Senergy Platinum CI Stucco Ultra wall system with related work of other sections.
- B. Coordinate and schedule installation of trim, flashing, and joint sealers to prevent water infiltration behind the system.

1.08 WARRANTY

- A. Provide Master Builders Solutions – Senergy standard warranty for Senergy Platinum CI Stucco Ultra wall system installations under provisions of Division 01 Warranty term varies with system component's configuration, reference Senergy Warranty Schedule technical bulletin for specific information.
- B. Comply with Master Builders Solutions notification procedures to assure qualification for warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. All components of the senergy platinum ci stucco ultra wall system shall be obtained from the system manufacturer or through an authorized distributor.

2.02 MATERIALS

- A. Air/Water-Resistive Barrier Components:
 - 1. Air/Water-Resistive Barrier:
 - a. SENERSHIELD-R: A one-component fluid-applied vapor permeable air/water-resistive barrier.
 - 2. Rough Opening and Joint Treatment:
 - a. MAXFLASH: A one-component elastomeric material for use as a flexible flashing membrane.
 - 3. Transitional Membrane / Expansion Joint Flashing
 - a. WS FLASH: 30-mil thick, self-sealing, self-healing composite membrane of polyester fabric and rubberized asphalt. Compatible with Senergy fluid-applied air/water-resistive barriers.
 - b. FLASHING PRIMER: A water-based primer for use prior to application of WS FLASH on all acceptable surfaces.
- B. Drainage Mat by Master Builders Solutions: Three-dimensional drainage core consisting of fused, entangled filaments.
- C. Insulation Board: (Required, Select One)
 - 1. Extruded polystyrene; ASTM C578, Type IV.

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- a. Flame spread less than 25, smoke developed less than 450 per ASTM E84, UL 723.
- b. Flexural: 50 psi, compressive: 25 psi, minimum thermal resistance 5/inch at 75°F (24°C) 4.55/inch at 40°F (4°C).
- c. Minimum density 1.55 lb./ft³ (25 kg/m³)
- d. Minimum thickness as indicated on drawings minimum 19 mm (3/4").
- e. Air-dried (aged) six weeks, or equivalent, prior to installation.
- f. Edges: square within 1/32" per ft. (0.8 mm per m).
- g. Thickness: tolerance of +/- 1/16" (1.6 mm).
- h. Maximum Size: 2' x 8' (61 cm x 2.44 m x 10 cm).
- i. Length and width: tolerance of +/- 1/16" (1.6 mm).

D. Lath/Plaster Base:

- 1. Expanded Metal Lath: The lath shall comply with ASTM C847. Furring and self-furring requirements shall be as set forth for wire lath. Minimum weight is 2.5 lbs./yd² (1.36 kg/m²). Refer to ASTM C 1063 for additional information.

E. Fastening for Rigid Insulation Board and Lath/Plaster Base:

- 1. Masonry: Minimum 3/16" (4.7mm) diameter corrosion resistant masonry Wind-lock type MT fastener with Wind-lock ULP 302 washer, Lath Plates or equal with 3/4" (19 mm) minimum penetration into masonry.

F. Stucco Base Coat:

- 1. STUCCOBASE PREMIX by Master Builders Solutions: Factory-blended stucco mixture of Portland cement, reinforcing fibers, sand, and proprietary ingredients.

G. Plaster Sand:

- 1. Must be clean and free from deleterious amounts of loam, clay, silt, soluble salts and organic matter. Sampling and testing must comply with ASTM C897. Plaster sand must be graded within the following limits: Percent retained by weight.

Retained on ± 2 Percent

U.S. Standard Sieve	Minimum	Maximum
No. 4		0
No. 8	0	10
No. 16	10	40
No. 30	30	65
No. 50	70	90
No. 100	95	100

H. Water: Clean and potable without foreign matter.

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- I. Senergy Adhesive/Base Coat: (Required for Trim Shapes and Reinforcing Mesh)
 - 1. ALPHA Base Coat: A 100% acrylic base coat, field-mixed with Type I or Type II Portland cement. It has a creamy texture that is easily spread.
 - 2. ALPHA DRY Base Coat: A dry-mix polymer adhesive and base coat containing Portland cement, and requires only water for mixing.
- J. Portland cement (Required if ALPHA BASE is Selected): Conform to ASTM C150, Type I, II, or I/II, grey or white; fresh and free of lumps.
- K. DIAMONDSHIELD Stucco Reinforcing Mesh by Master Builders Solutions: A balanced, open-grid triaxial glass fiber mesh that distributes stress across three directions for superior crack resistance properties on new or retrofit stucco applications.
- L. STUCCO PRIME by Master Builders Solutions: A 100% acrylic-based primer that help alleviate shadowing and reduces chances of efflorescence with standard finishes; color to closely match the selected Senergy Finish Color.
- M. Senergy Finish Coat:
 - 1. SENERLASTIC Finish: 100% acrylic based, textured elastomeric finish that provides excellent
 - 2. flexibility, weatherability, and maximum resistance to mildew growth, air cured, compatible with base coat; Senergy finish color will be selected by architect/owner from full color range; finish texture to be selected by architect/owner from sample of either:
 - a. FINE: Utilizes uniformly-sized aggregates for a uniform, fine texture. (OR)
 - b. TEXTURE: Can achieve a wide variety of free-formed, textured appearances, including stipple and skip-trowel

2.03 ACCESSORIES

- A. Trim: Casing bead, corner bead, expansion joint and weep screed accessories shall meet the requirements of ASTM C1063. Accessories shall be vinyl, meeting ASTM D1784; galvanized, meeting ASTM A525 and ASTM A526; or zinc, meeting ASTM B69. Vinyl or zinc accessories are recommended where highly humid or salt-laden service conditions exist. Refer to Senergy's Stucco Wall Systems Lath and Trim Accessories technical bulletin for additional information.
 - 1. C-I Weep Track by Clark Dietrich or AMICO: For returning insulated stucco into doors windows, etc.
 - 2. Foundation weep screed: Beveled edge designed to terminate finish system and drain internal moisture.
 - 3. Casing bead: Square edge style.
 - 4. Corner bead: Small radius nose style.
 - 5. Control joints: W-shaped accordion profile style.

6. Expansion joints: Pair of casing beads spaced for application of sealant bead.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify project site conditions under provisions of division 01.
- B. Walls:
 1. Substrates:
 - a. When applying Senergy Air/Water-Resistive Barriers to concrete/unit masonry, verify concrete/unit masonry is free of dust, dirt, grease, oils, laitance, efflorescence, biological residue, existing paint or coatings, curing compounds, form release agents, or any other contaminants which might affect the bond. Masonry walls should be properly cured to full load bearing capacity, laid true, and with joints tooled. Properly prepared concrete will have an open texture similar to fine grit sandpaper.
 - b. Examine surfaces to receive system and verify that substrate and adjacent materials are dry, clean, and sound. Verify substrate surface is flat, free of fins or planar irregularities greater than 1/4" in 10' (6 mm in 3 m).
 2. Flashings:
 - a. All flashings are by others and must be installed in accordance with specific manufacturer's requirements. Where appropriate, end-dams must be provided.
 - b. Openings must be flashed prior to window/door, HVAC, etc. installation. Refer to *Secondary Moisture Protection Barrier Guidelines for Senergy Stucco Wall System* technical bulletin or *Air/Water-Resistive/Vapor Barrier Application Guidelines* technical bulletin for further guidance.
 - c. Windows and openings shall be flashed per design and building code requirements.
 - d. Individual windows that are ganged to make multiple units require continuous head flashing and/or the joints between the units must be fully sealed.
 3. Roof: Verify that all roof flashings have been installed in accordance with the guidelines set by the Asphalt Roofing Manufacturers Association (ARMA).
 4. Kick-out Flashing: Kick-out flashing must be installed where required. The kick-out flashing must be leak-proof and angled (min 100°) to allow for proper drainage and water diversion. Refer to SENERGY Platinum CI Stucco Ultra wall system typical details.
- C. Do not proceed until all unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect all surrounding areas and surfaces from damage and staining during application of SENERGY Platinum CI Stucco Ultra wall system.
- B. Protect finished work at end of each day to prevent water penetration.

3.03 MIXING

General: no additives are permitted unless specified in product mixing instructions. Close containers when not in use. Prepare in a container that is clean and free of foreign substances. Do not use a container which has contained or been cleaned with a petroleum-based product. Clean tools and equipment with water immediately after use. Dried material can only be removed mechanically.

A. Air/Water-Resistive Barriers:

- 1. SENERSHIELD-R/RS/VB: Mix with a clean, rust-free paddle and drill until thoroughly blended. Do not add water.
- 2. Cold Temperature Additive: LT ADDITIVE: Pour the entire contents of one (1) bottle of LT ADDITIVE into one (1) full pail of SENERSHIELD-R, SENERSHIELD-RS or SENERSHIELD-VB. Mix with a clean, rust-free paddle and drill until fully blended.

B. Stucco Base Coat:

- 1. STUCCOBASE: Use mixer which is clean and free of foreign substances. Add 5-6 gallons (18.9-22.7 liters) of clean potable water to mixer per one bag of STUCCOBASE. Add one bag of STUCCOBASE and one half 100-120 lbs. (45.4-54.4 kg) of the required plaster sand (ASTM C144 or ASTM C897). Mix for 3-4 minutes at normal mixing speed while adding the remainder 100-120 lbs. (45.4-54.4 kg) of the plaster sand. Allow material to set for 2-4 minutes and then remix adding water to achieve desired consistency. Desired consistency varies with type of application (trowel or gun), substrate (paper-backed lath or block) and whether the stucco is applied to a wall or a ceiling. Note: Continuous mixing may cause excessive air entrainment.
- 2. STUCCOBASE PREMIX: Use mixer which is clean and free of foreign substances. Add 2-2.5 gallons (7.6-9.5 liters) of clean potable water to mixer. Slowly add one bag of STUCCOBASE PREMIX. Mix for one minute at normal mixing speed. Allow material to set for 2-4 minutes with mixing blades at rest. Then re-mix, adding water to achieve desired consistency. Desired consistency varies with type of application (trowel or gun), substrate (paper-backed lath or block) and whether the stucco is applied to a wall or a ceiling. Note: Continuous mixing may cause excessive air entrainment.

C. Senergy Base Coat:

- 1. ALPHA Base Coat: Mix base coat with a clean, rust-free paddle and drill until thoroughly blended, before adding Portland cement. Mix one part (by weight) Portland cement with one part base coat. Add Portland cement in small increments,

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mixing until thoroughly blended after each additional increment. Clean, potable water may be added to adjust workability.

2. ALPHA DRY Base Coat: Mix and prepare each bag in a 19-liter (5-gallon) pail. Fill the container with approximately 5.6-liters (1.5-gallons) of clean, potable water. Add ALPHA DRY Base Coat in small increments, mixing after each additional increment. Mix ALPHA DRY Base Coat and water with a clean, rust-free paddle and drill until thoroughly blended. Additional ALPHA DRY Base Coat or water may be added to adjust workability.
- D. STUCCO PRIME and TINTED PRIMER: Mix the factory-prepared material with a clean, rust-free paddle and drill until thoroughly blended. A small amount of clean, potable water may be added to adjust workability. Do not overwater.
- E. Senergy Finishes - SENERFLEX, SENERLASIC, SENERLASTIC PLUS, SENERFLEX TERSUS, CHROMA, and ENCAUSTO VERONA Finish: Mix the factory-prepared material with a clean, rust-free paddle and drill until thoroughly blended. A small amount of clean, potable water may be added to adjust workability. Do not overwater, 10 oz maximum.
- F. Specialty Finish - AURORA TC-100, AURORA STONE, and ALUMINA Finish: Gently mix the contents of the pail for 1 minute using a low RPM ½” drill equipped with a mixing paddle such as a Demand Twister or a Wind-lock B-MEW, B-M1 or B-M9.

3.04 APPLICATION

- A. Accessories:
- B. Attach Window/Door Drip Edge level and per manufacturer's instructions.
- C. Air/Water-Resistive Barrier:
1. Substrate shall be dry, clean, sound, and free of releasing agents, paint, or other residue or coatings. Verify substrate is flat, free of fins or planar irregularities greater than 1/4" in 10' (6.4 mm in 3 m).
 2. Unsatisfactory conditions shall be corrected before application of the Senergy air/water-resistive barriers.
 3. Apply the MAXFLASH in accordance with MAXFLASH product bulletin.
 4. Installed materials shall be checked before continuing system application.
 5. Installed materials shall be checked before continuing system application.
- D. DRAINAGE MAT:
1. Apply DRAINAGE MAT horizontally or vertically over Senergy Air/Water-Resistive Barrier ensuring it is free of wrinkles.
 2. Abut all vertical and horizontal edge and Secure DRAINAGE MAT to substrate with sufficient building staples or galvanized nails to remain in place prior to application of insulation board.

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E. Insulation Board:

1. Vertical Surfaces: begin at base of wall with firm temporary support
2. Apply horizontally in running bond pattern.
3. Precut insulation board to fit openings and projections and install as a single piece around corners of openings. Stagger vertical joints and corners. Stagger insulation board and sheathing joints.
4. Abut all joints and ensure an overall flush surface.
5. With appropriate fastening system, temporarily secure insulation board with minimum two fasteners per board.
6. Rasp flush any irregularities that would interfere with proper application of lath.

F. Trim: Refer to Senergy Stucco Wall Systems Lath and Trim Accessories technical bulletin.

G. Lath: Install in accordance with all local code requirements, applicable standards and application procedures.

1. Expanded Metal Lath

- a. The metal lath shall be applied with minimum 1/2" (13 mm) side laps and 1" (25 mm) end laps.
- b. When end laps occur between supports, lace or wire ties the ends of the sheets with 0.0475" (1.2 mm) galvanized annealed steel wire.
- c. Refer to ASTM C1063 for additional fastening information.

H. Stucco Base Coat:

1. Senergy Platinum CI Stucco Ultra wall system application 3/8"–1/2" thickness (9.5-12.7mm).
 - a. Following surface preparation and installation of the lath and accessories apply selected Master Builders Solutions stucco base mixture to the approved substrate by hand troweling or machine spraying to a thickness of 3/8" to 1/2" (9.5-12.77mm), completely embedding the lath.
 - b. Use rod and darby to level the applied base coat without exposing the lath.
 - c. After initial set begins and surface has sufficiently hardened, use sponge or hard rubber float as required to fill voids, holes or imperfections, leaving the surface ready to receive Senergy Finish.
 - d. At subcontractor's option, the double back method of application, whereby the first and second coats are applied and cured as one system, may be used. If this system is used, the second coat (brown) should be applied as soon as the first coat is rigid.

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- e. Damp cure for at least 48 hours by lightly and evenly fogging the surface with water at least twice a day. Direct sunlight, hot temperatures, low humidity and windy conditions may make additional fogging necessary.
 - f. Allow stucco base to cure a minimum of 6 days prior to application of EPS board shapes, Senergy base coat, STUCCOPRIME or Senergy Finish application.
2. Senergy Platinum CI Stucco Ultra wall system application 3/4"–7/8" thickness (19-22mm).
- a. Nominal plaster base coat thickness:
 - 1) First coat "scratch": 3/8" (9.5mm)
 - 2) Second coat "brown": 3/8" (9.5mm)
 - b. Apply first coat to completely embed lath. Cross rake to provide key for second brown coat. Coat must be uniform in thickness. Ensure the first coat is properly "scratched" and sufficiently rigid to resist cracking prior to application and leveling of the second or "brown" coat.
 - c. Dampen scratch coat, apply second brown coat to provide the required total thickness. Trowel stucco base into trim to seat trim. The lath shall be fully embedded in the coating and shall be completely covered. Coat must be uniform in thickness. Rod off to desired thickness, leveled with screeds, to provide a true, flat plane. Follow this by wood floating or darbying the surface.
 - d. After the surface has sufficiently hardened, use sponge or hard rubber float as required to fill voids, holes or imperfections, leaving the surface ready to receive Senergy Finish.
 - e. Damp cure for at least 48 hours by lightly and evenly fogging the surface with water at least twice a day. Direct sunlight, hot temperatures, low humidity and wind may make additional fogging necessary.
 - f. Allow stucco base to cure a minimum of 6 days prior to application of EPS board shapes, Senergy Base Coat, STUCCOPRIME or Senergy Finish application.
- I. Senergy Adhesive/Base Coat:
- 1. Apply a skim coat of Senergy Base Coat, approximately 1/16" (1.6mm) thick to properly cured "brown coat" of stucco base.
 - 2. Allow to dry hard (normally 8 to 10 hours).
- J. DIAMONDSHIELD Reinforcing Mesh:
- 1. Base coat shall be applied to achieve reinforcing mesh embedment with no reinforcing mesh color visible.
 - 2. Install DIAMONDSHIELD over properly cured Senergy Platinum CI Stucco Ultra System "brown coat" of stucco base.

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3. Apply mixed Senergy Base Coat to entire surface of "brown coat" with a stainless-steel trowel to embed the reinforcing mesh.
4. Immediately place DIAMONDSHIELD Reinforcing Mesh against wet base coat and embed the reinforcing mesh into the base coat by troweling from the center to the edges.
5. Lap reinforcing mesh 2 1/2" (64 mm) minimum at edges.
6. Ensure reinforcing mesh is continuous at corners, void of wrinkles and embedded in base coat so that no reinforcing mesh color is visible.
7. If required, apply a second layer of base coat to achieve total nominal base coat/reinforcing mesh thickness of 1/16" (1.6 mm).
8. Allow base coat with embedded reinforcing mesh to dry hard (normally 8 to 10 hours).

K. STUCCO PRIME and TINTED PRIMER:

1. Apply Primer to the base coat/reinforcing mesh with a sprayer, 3/8" (10 mm) nap roller, or good quality latex paint brush at a rate of approximately 150- 250 ft² per gallon (3.6–6.1m² per liter).
2. Primer shall be dry to the touch before proceeding to the Senergy Finish coat application.

L. Senergy Finish Coat: SENERFLEX, SENERLASTIC, SENERLASTIC PLUS, SENERFLEX TERSUS and CHROMA.

1. Apply Senergy Finish directly to the base coat with a clean, stainless steel trowel.
2. Apply and level Senergy Finish during the same operation to minimum obtainable thickness consistent with uniform coverage.
3. Maintain a wet edge on Senergy Finish by applying and texturing continually over the wall surface.
4. Work Senergy finish to corners, joints or other natural breaks and do not allow material to set up within an uninterrupted wall area.
5. Float Senergy Finish to achieve final texture.

3.05 CLEANING

- A. Clean work under provisions of Division 01
- B. Clean adjacent surfaces and remove excess material, droppings, and debris.

3.06 PROTECTION

- A. Protect Stucco Base from rain, snow and frost for 48-72 hours following application.

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- B. Protect Senergy base coat, air/water-resistive barriers, primer and finish from rain and temperatures below 40°F (4°C) for 24 hours or until dry.
- C. Protect installed construction under provisions of Division 01

END OF SECTION

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SECTION 09240

SENTRY STUCCO WITH MASTERSEAL® 581 WALL SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Refer to all project drawings and other sections of this specification to determine the type and extent of work therein affecting the work of this section, whether or not such work is specifically mentioned herein.
- B. System Description: Composite wall system consisting MasterSeal® 581 waterproofing, STUCCOBASE™/ STUCCOBASE™ PREMIX by Master Builders Solutions, STUCCOPRIME (optional) and Senergy Finish Coat.
- C. Senergy products are listed in this specification to establish a standard of quality. Any substitutions to this specification shall be submitted to and receive approval from the Architect at least 10 days before bidding. Proof of equality shall be borne by the submitter.
- D. The system type shall be Sentry Stucco with MasterSeal 581 Wall System as manufactured by Master Builders Solutions, Shakopee, MN.

1.02 RELATED SECTIONS

- A. Section 04220 Concrete Block Masonry
- B. Section 07190 Vapor barriers
- C. Section 08000 Openings

1.03 REFERENCES

- A. ASTM C150 Standard Specification for Portland Cement
- B. ASTM C926 Standard Specification for Application of Portland Cement-Based Plaster
- C. ASTM D1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds
- D. ICC-ES AC11 Cementitious Exterior Wall Coatings
- E. CCRR 0230 Intertek Code Compliance Research Report (STUCCOBASE/ STUCCOBASE PREMIX)

1.04 SUBMITTALS

- A. Submit under provisions of Section 01300
- B. Product Data: Provide data on Sentry Stucco with MasterSeal 581 Wall System materials, product characteristics, performance criteria, limitations and durability.

- C. Code Compliance: Provide manufacturer’s applicable code compliance report.
- D. Samples: Submit two inch size samples of Sentry Stucco with MasterSeal 581 Wall System illustrating Finish Coat color and texture range.
- E. Certificate: System manufacturer’s approval of applicator.
- F. Sealant: Sealant manufacturer’s certificate of compliance with ASTM C1382.
- G. System manufacturer’s current specifications, typical details, system design guide and related product literature which indicate preparation required, storage, installation techniques, jointing requirements and finishing techniques.

1.05 QUALITY ASSURANCE

- A. Manufacturer: More than 10 years in the cement plaster stucco industry, with more than 1000 completed cement plaster stucco projects.
- B. Applicator: Approved by Master Builders Solutions in performing work of this section.
- C. Regulatory Requirements: Conform to applicable code requirements for cement plaster stucco.
- D. Field Samples
 - 1. Construct one field sample panel for each color and texture, 2 feet in size of system materials illustrating method of attachment, surface finish color and texture.
 - 2. Prepare each sample panel using the same tools and techniques to be used for the actual application.
 - 3. Locate sample panel where directed.
 - 4. Accepted sample panel may not remain as part of the work.
 - 5. Field samples shall be comprised of all wall assembly components including substrate, MASTERSEAL 581, plaster trim accessories, STUCCOBASE™/STUCCOBASE™ PREMIX by Master Builders Solutions, STUCCOPRIME (if specified), Senergy Finish Coat and typical sealant/flashing conditions.

E. Testing:

1. Sentry Stucco with MasterSeal 581 Wall System and Component Performance:

TEST	METHOD	CRITERIA	RESULTS
Freeze-thaw Resistance	Per ICC-ES acceptance criteria AC-11	No sign of deleterious effects after 10 cycles	STUCCOBASE passed with no visible evidence of deterioration when examined under 5x magnification
Water Vapor Transmission	ASTM E96 -Wet Cup	Report Value	STUCCOBASE 20.4 perms
Compressive Strength	ASTM C109	Report Value	22.4 MPa (3245 psi) average for STUCCOBASE
Flexural Strength	ASTM C348	Report Value	4.57 MPa (663 psi) average for STUCCOBASE
Surface Burning	ASTM E84	Report Value	<25 Flame Spread <450 Smoke Developed Includes StuccoBase, and Senergy Finishes

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Non-Combustibility	ASTM E136	No flaming, excess temperature rise or weight loss when exposed to 750°C (1382°F)	Pass StuccoBase
Fire Resistance Rated Assemblies	ASTM E119	No transmission of heat greater than 250°F above ambient; no passage of flame or hot gasses; no passage of water from hose stream test; for loadbearing walls – ability to withstand load under test conditions	Does not affect rating of concrete or masonry wall

2. MASTERSEAL 581:

PROPERTY	RESULTS	TEST METHOD
Initial Set, min at 70 °F (21 °C), 50% rh	10	Lab Method
Final Set, at 70 °F (21 °C), 50% rh	90	Lab Method
Density, (cured), lbs/ft3 (kg/m3)	129 (2,080)	Lab Method
Positive resistance to hydrostatic pressure, hrs, at 200 psi (1.4 MPa), 461 head ft, air cured at 70 °F (21 °C), 50% rh	752 No leakage, no softening	CRD C 48, modified
Negative resistance to hydrostatic pressure, hrs, at 200 psi (1.4 MPa), 461 head ft, air cured at 70 °F (21 °C), 50% rh	664 Limit Dampness	CRD C 48, modified
Water absorption, %, boiling water submersion at 24 hours	3.6	ASTM C 67 (Section 7.3)
Compressive strength, psi (MPa) 7 days 28 days	4,200 (29) 6,030 (42)	ASTM C 109
Flexural strength, psi (MPa) 7 days 28 days	360 (2.5) 1,027 (7)	ASTM C 348
Tensile strength, psi (MPa) 7 days 28 days	250 (2) 440 (3)	ASTM C 190
Artificial weathering, hrs. Xenon Arc Carbon Arc	5,000 = No failure 500 = No failure	ASTM G 26 ASTM G 23
Adhesion strength, psi (MPa)	418 (2.9)	Test by tensile bond
Artificial weathering, 500 hours	No cracking, loss of adhesion, checking, or other defect	Atlas Type DMC weatherometer
Freeze/thaw resistance, 200 cycles	No change	ASTM C 666 (Procedure B)

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Salt spray resistance, 300 hours	No defect	ASTM B 117
Carbon Dioxide (CO ₂), in (mm)	1/16 (1.6) Equivalent to 3/4" (19 mm) new concrete	Lab Method Diffusion
Permeance, perms	12 (0.10698) 8 x 103 resistance	ASTM E 96 (water-vapor transmission) Swedish standard SS-02-15-82
Wind-driven rain, hrs	8 = excellent	Fed. Spec. TT-P-0035 (Para 4.4.7)
Coefficient of thermal expansion, in/in/°F (mm/mm/°C), at 28 days	6.99 x 10 ⁻⁶ (5 x 10 ⁻⁷)	ASTM C 531
Impact strength (Gardener impact tester)	No chipping	Fed. Spec. TT-P-0035 (Cement paints para. 3.4.8)
Hardness, (Barber Coleman Impressor) Requirement min = 30, max = 60 7 days 14 day 21 days	35 47 52	Fed. Spec. TT-P-0035 (para 4.4.9)
Abrasion resistance, 3,000 L sand	Passed	Fed. Spec. TT-P-141B
Standard Reflectance Gray MasterSeal 581 White MasterSeal 581	64.2 88.1	ASTM D 2244 using Hunterlab D- 25 meter
Fungus resistance, at 21 days	No growth; meets all requirements	Fed. Spec. TT-P-29B
Surface burning characteristics Flame Spread Smoke developed	0 5	ASTM E 84
Fire Propagation Flame spread	Index = 1.5 Class 1	BS476: Part 6:1981 BS476: Part 7:1971

1.01 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle products under provisions of Section 01660.
- B. Deliver Master Builders Solutions materials in original unopened packages with manufacturer's labels intact.
- C. Protect Master Builders Solutions materials during transportation and installation to avoid physical damage.
- D. Store Master Builders Solutions materials in cool, dry place protected from freezing. Store at no less than 40°F/4°C (50°F/10°C AURORA STONE, AURORA TC-100 and ALUMINA finish).
- E. Store insulation boards flat and protected from direct sunlight and extreme heat.
- F. Store Reinforcing Mesh flexible flashing in cool, dry place.

1.02 PROJECT/SITE CONDITIONS

- A. Do not apply Master Builders Solutions material in ambient temperatures below 40°F/4°C (50°F/10°C for AURORA STONE, AURORA TC-100 and ALUMINA Finish). Provide properly vented, supplementary heat during installation and drying period when temperatures less than 40°F/4°C (50°F/10°C for AURORA STONE, AURORA TC-100 and ALUMINA Finish) prevail.
- B. Do not apply materials to frozen surfaces.

- C. Maintain ambient temperature at or above 40°F/4°C (50°F/10°C for AURORA STONE, AURORA TC- 100 and ALUMINA Finish) during and at least 24 hours after Sentry Stucco Ultra Wall System installation and until dry.

1.03 SEQUENCING AND SCHEDULING

- A. Coordinate and schedule installation of Sentry Stucco with MasterSeal 581 Wall System with related work of other sections.
- B. Coordinate and schedule installation of trim, flashing, and joint sealers to prevent water infiltration behind the system.

1.04 WARRANTY

- A. Provide Master Builders Solutions – Senergy standard material warranty for Sentry Stucco with MasterSeal 581 Wall System installations under provisions of Section 01740. Warranty term varies with system component's configuration, reference Senergy Warranty Schedule technical bulletin for specific information.
- B. Comply with Master Builders Solutions notification procedures to assure qualification for warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. All components of the Sentry Stucco with MasterSeal 581 Wall System shall be obtained from the system manufacturer or through an authorized distributor.

2.02 MATERIALS

- A. MASTERSEAL 581 Waterproof Barrier: Portland cement-based coating for concrete and masonry that resists both air infiltration and positive as well as and negative hydrostatic pressure. Polymer-modified with MASTEREMACO A 660, MasterSeal 581 creates a low maintenance and highly durable waterproof barrier
- B. MASTEREMACO A 660: An acrylic-polymer emulsion which enhances the adhesion, physical properties and durability of MASTERSEAL 581.
- C. Stucco Base Coat: (~~Required, Select One~~)
 - 1. STUCCOBASE by Master Builders Solutions: Factory-blended stucco mixture of Portland cement, reinforcing fibers, and proprietary ingredients.
- D. Water: Clean and potable without foreign matter.
- E. Adhesives/Base Coats:
 - 1. ALPHA Base Coat: A 100% acrylic base coat, field-mixed with Type I or Type II Portland cement. It has a creamy texture that is easily spread.
 - 2. STUCCO SURFACE LEVELER by Master Builders Solutions: A polymer-modified dry-mix leveling and embedment coat for use with Senergy Stucco Systems and other Portland Cement Based Stucco

- F. Portland Cement: Conform to ASTM C150, Type I, II, or I/II, grey or white; fresh and free of lumps.
- G. SRT MESH by Master Builders Solutions; a woven fiberglass mesh with mechanical strength and dimensional stability for superior crack resistance properties on new or retrofit stucco applications.
- H. STUCCOPRIME Prime by Master Builders Solutions: A 100% acrylic-based primer; color to closely match the selected Senergy Finish Color.

2.03 ACCESSORIES

- A. Trim: Casing bead, corner bead, expansion joint and weep screed accessories shall meet the requirements of ASTM C1063. Accessories shall be: vinyl, meeting ASTM D1784; galvanized, meeting ASTM A525 and ASTM A526; or zinc, meeting ASTM B69. Vinyl or zinc accessories are recommended where highly humid or salt-laden service conditions exist. Refer to Senergy's Stucco Wall Systems Lath and Trim Accessories bulletin for additional information.
 - 1. Foundation weep screed: Beveled edge designed to terminate finish system and drain internal moisture.
 - 2. Casing bead: Square edge style.
 - 3. Corner bead: Small radius nose style.
 - 4. Control joints: W-shaped accordion profile style.
 - 5. Expansion joints: Two piece type slip-joint design or pair of casing beads spaced for application of sealant bead

PART 3 - EXECUTION

3.01 EXAMINATION

A. Walls

1. Substrates

- a. Acceptable substrates are poured concrete and unit masonry.
- b. Verify concrete/unit masonry is free of dust, dirt, grease, oils, laitance, efflorescence, biological residue, existing paint or coatings, curing compounds, form release agents, or any other contaminants which might affect the bond of MASTERSEAL 581. Properly prepared concrete will have an open texture similar to fine grit sandpaper. Masonry walls should be properly cured to full load bearing capacity, laid true, and with joints tooled.
- c. Examine surfaces to receive system and verify that substrate and adjacent materials are dry, clean, and sound. Verify substrate surface is flat, free of fins or planar irregularities greater than 1/4" in 10' (6 mm in 3 m).

2. Flashings:

- a. All flashings are by others and must be installed per project design detailing. Where appropriate, end-dams must be provided.
 3. Roof: Verify that all roof flashings have been installed in accordance with the guidelines set by the Asphalt Roofing Manufacturers Association (ARMA).
- B. Kick-out Flashing: Must be installed where required. The kick-out flashing must be leak-proof and angled (min 100°) to allow for proper drainage and water diversion. Do not proceed until all unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Protect all surrounding areas and surfaces from damage and staining during application of Sentry Stucco with MasterSeal 581 Wall System.
- B. Protect finished work at end of each day to prevent water penetration.

3.03 MIXING

General: No additives are permitted unless specified in product mixing instructions. Close containers when not in use. Prepare in a container that is clean and free of foreign substances. Do not use a container which has contained or been cleaned with a petroleum-based product. Clean tools and equipment with water immediately after use. Dried material can only be removed mechanically.

- A. MASTERSEAL 581 and MASTEREMACO A 660: Mix MASTERSEAL 581 with a mixing liquid consisting of a blend of MASTEREMACO A 660 diluted with water. Maximum dilution ratio is one part MASTEREMACO A 660 (1½ quarts) to three parts water (4½ quarts). Approximately 6 quarts of mixing liquid is needed per 50 lbs. of MASTERSEAL 581 powder. For best results, mechanically mix MASTERSEAL 581 with a slow-speed drill and mixing paddle. Gradually add the powder to the mixing liquid while drill is running.
- B. Stucco Base Coat:
 1. STUCCOBASE PREMIX: Use mixer which is clean and free of foreign substances. Add 2-2.5 gallons (7.6-9.5 liters) of clean potable water to mixer. Slowly add one bag of STUCCOBASE PREMIX. Mix for one minute at normal mixing speed. Allow material to set for 2-4 minutes with mixing blades at rest. Then re-mix, adding water to achieve desired consistency. Desired consistency varies with type of application (trowel or gun), substrate and whether the stucco is applied to a wall or a ceiling.
- C. Adhesives/Leveler Base Coats:
 1. ALPHA Base Coat: Mix base coat with a clean, rust-free paddle and drill until thoroughly blended, before adding Portland cement. Mix one-part (by weight) Portland cement with one-part base coat. Add Portland cement in small increments, mixing until thoroughly blended after each additional increment. Clean, potable water may be added to adjust workability.
 2. STUCCO SURFACE LEVELER: Mix and prepare each bag in a 5-gallon (19-liter) pail. Fill the container with approximately 1.3-gallons (6 liters) of clean, potable water. Add leveler in small increments, mixing after each additional increment. Mix leveler and water with a clean, rust-free paddle and drill until thoroughly blended.

Additional 0.3 gallons of water for a maximum of 1.6 gallons (6 liters) may be added to adjust workability. Retemper before use if needed. Let stand for 5 to 10 minutes, then remix for 1 minute.

- D. Primer: Thoroughly mix the factory prepared STUCCOPRIME with a paddle and drill to a uniform consistency. A small amount of clean, potable water may be added to adjust workability.
- E. Senergy Finish Coat:
 - 1. SENERFLEX, MAXLASTIC, SENERFLEX TERSUS, CHROMA and ENCAUSTO VERONA Finish: Mix the factory-prepared material with a clean, rust-free paddle and drill until thoroughly blended. A small amount of clean, potable water may be added to adjust workability. Do not overwater.

3.04 APPLICATION

- A. MASTERSEAL 581 Waterproof Barrier: Dampen concrete or unit masonry (SSD) just prior to MASTERSEAL 581 application. Apply with a stiff bristle brush using a two coat application. Brush apply first coat vertically and second coat horizontally, as this will allow the MASTERSEAL 581 to act as a scratch coat for the stucco. Allow 24 hours between coats. The total thickness of the 2 coats should not exceed 1/8". Allow second coat of MASTERSEAL 581 to cure 24 hours prior to STUCCOBASE application. Install according to the manufacturer's specifications and all applicable building code requirements. The waterproof barrier shall be free of any damage such as holes or breaks and must be applied to all surfaces to receive the Sentry Stucco with MasterSeal 581 Wall System. Wrap the water resistive barrier into rough openings (doors, windows, etc.) Coordinate work with other trades to assure proper sequencing, detailing and installation of materials.
- B. Trim Junction: When two pieces of trim abut: Set intersection of trim in a minimum 4" (100 mm) bed of acceptable trim sealant. Allow 1/8"-3/16" (3-5 mm) gap between the abutting trim pieces. Do not overlap trim. Attach the trim in accordance with manufacturer's specifications, true expansion joints must be fastened to the structural substrate.
 - 1. When two or more pieces of trim intersect: The vertical trim piece shall be continuous with all horizontal pieces. Miter all corners at intersections of trim, set intersection of trim in a minimum 4" (100 mm) bed of acceptable trim sealant. Allow 1/8"-3/16" (3-5 mm) gap between the intersecting trim pieces. Do not overlap the trim. Attach the trim in accordance with manufacturers' specifications.
NOTE TO SPECIFIER: It is the sole responsibility of the project design team, including the architect, engineer, etc., to ultimately determine specific expansion and control joint placement, width and design.
- C. STUCCOBASE/STUCCOBASE PREMIX Base Coat: Apply the STUCCOBASE/STUCCOBASE PREMIX mixture to the cured MASTERSEAL 581 by hand troweling to a thickness of 3/8" to 1/2". Use rod and darby to level the applied stucco base coat. After initial set begins and surface has sufficiently hardened, use sponge or hard rubber float as required to fill voids, holes or imperfections, leaving the surface ready to receive Senergy finish coat. At subcontractor's option, the double

back method of application, whereby two coats (scratch and brown) are applied and cured as one system, may be used. If this system is used, the second coat (brown) should be applied as soon as the first coat is rigid and able to support the second coat. For either application method, damp cure for at least 48 hours by lightly and evenly fogging the surface with water at least twice a day. Direct sunlight, hot temperatures, low humidity and windy conditions may make additional fogging necessary. Allow STUCCOBASE/STUCCOBASE PREMIX to cure a minimum of 6 days prior to application of EPS insulation board shapes, Senergy base coat and reinforcing mesh, STUCCOPRIME or Senergy finish coat.

NOTE: MASTERSEAL 581 and STUCCOBASE application should not exceed a total of 5/8".

- D. STUCCOPRIME Primer: Apply to STUCCOBASE or "brown" coat with a sprayer, 3/8" (10mm) nap roller or good-quality latex paint brush at a rate of approximately 150-250ft² per gallon (3.6-6.1m² per liter). STUCCOPRIME shall be dry to the touch before proceeding with the Senergy finish coat application.
- E. Adhesive/Base Coat:
1. As a base coat: apply a skim coat of Senergy base coat, approximately 1/16" (1.6mm) thick to properly cured "brown coat" of stucco base coat.
 2. As an adhesive: Apply mixed base coat to entire surface of insulation board using a stainless-steel trowel with 1/2"x1/2" (13mm x 13mm) notches spaced 1/2" (13mm) apart or 3/8"x3/8" (10mm x 10mm) notches spaced 3/8" (10 mm) apart.
- F. SRT Mesh: Apply mixed selected Base/Level Coat to entire surface of stucco with a stainless-steel trowel. Immediately place mesh against wet Senergy Base/Level Coat and embed mesh into the Base/Level Coat by troweling from center to the edges. Lap SRT MESH 2 1/2" (64mm) minimum at edges. Ensure mesh is continuous, void of wrinkles and embedded in Base Coat so that no mesh is visible. If required, apply a second layer of Base Coat to achieve total nominal Base Coat / SRT MESH thickness of 1/16" (1.6mm). Allow Base Coat with embedded mesh to dry hard (normally 8 to 10 hours) prior to finish coat application.
- G. Senergy Finish Coat: SENERFLEX, MAXLASTIC, SENERFLEX TERSUS and CHROMA Finish
1. Apply Senergy Finish directly to the base coat with a clean, stainless steel trowel.
 2. Apply and level Senergy Finish during the same operation to minimum obtainable thickness consistent with uniform coverage.
 3. Maintain a wet edge on Senergy Finish by applying and texturing continually over the wall surface.
 4. Work Senergy finish to corners, joints or other natural breaks and do not allow material to set up within an uninterrupted wall area.
 5. Float Senergy Finish to achieve final texture.
- H. ALIMINA Finish:

1. Apply TINTED PRIMER by Master Builders Solutions to substrate in accordance with current product bulletin. Primer shall be of corresponding color for selected ALUMINA Finish color. Allow Primer to dry to the touch before proceeding Finish application.
2. Apply a tight coat of finish with a clean, stainless-steel trowel.
3. Maintain a wet edge on finish by applying and leveling continually over the wall surface.
4. Work finish to corners, joints or other natural breaks and do not allow material to set up within an uninterrupted wall area. Allow first coat to set until surface is completely dry prior to applying a second coat of finish.
5. Use a stainless-steel trowel and apply the second coat of finish. Achieve final texture using circular motions.
6. Total thickness of finish may be between 1/16" (1.6 mm) and 1/8" (3.2 mm).

3.05 CLEANING

- A. Clean adjacent surfaces and remove excess material, droppings, and debris.

3.06 PROTECTION

- A. Protect base coat from rain, snow and frost for 48–72 hours following application.
- B. Protect installed construction.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. The Contractor shall furnish all labor, tools, materials, supervision and equipment necessary to do all the work specified herein and as required for a complete installation, including surface preparation, priming and painting of Contractor furnished equipment, materials, and structures.
- B. Section includes:
 - 1. Paint Materials
 - 2. Shop Painting
 - 3. Field Painting
 - a. Surface Preparation
 - b. Piping and Equipment Identification
 - c. Schedule of Colors
 - d. Work in Confined Spaces
 - e. OSHA Safety Colors

1.02 GENERAL INFORMATION AND DESCRIPTION

- A. The term "paint," as used herein, includes emulsions, enamels, paints, stains, varnishes, sealers, cement filler, cement epoxy fillers and other coatings, whether used as prime, intermediate, or finish coats.
- B. All paint for concrete and metal surfaces shall be especially adapted for use in and around water and wastewater treatment facilities and shall be applied in conformance with the manufacturer's published specifications.
- C. All paint for final coats shall be fume resistant, compounded with pigments suitable for exposure to sewage gases, especially to hydrogen sulfide and to carbon dioxide. Pigments shall be materials which do not tend to darken, discolor, or fade due to the action of sewage gases. If a paint manufacturer proposes use of paint which is not designated "fume resistant" in its literature, it shall furnish full information concerning the pigments used in this paint.
- D. Provide primers and intermediate coats produced by same manufacturer as finish coat. Use only thinners approved by paint manufacturer, and only within manufacturer's recommended limits.

- E. Coatings used in conjunction with potable water supply systems shall have U.S. Environmental Protection Agency (EPA) and FDA approval for use with potable water and shall not impart a taste or odor to the water.
- F. All building, facilities, structures, and appurtenances, as indicated on the Drawings and as specified herein, shall be painted with not less than one shop coat and two field coats, or one prime coat and two finish coats of the appropriate paint. Items to be painted include, but are not limited to, exterior and interior concrete, structural steel, miscellaneous metals, steel and aluminum doors and frames, concrete block, ductwork, sluice gates, operators, pipe fittings, valves, mechanical equipment, motors, conduit, and all other work which is obviously required to be painted unless otherwise specified.
- G. Baked on enamel finishes and items with standard shop finishes such as graphic panels, electrical equipment, toilet partitions, lockers, instrumentation, etc., shall not be field painted unless the finish is damaged during shipment or installation. Aluminum, stainless steel, fiberglass and bronze work shall not be painted unless color coding and marking is required or otherwise specified. A list of surfaces not to be coated is included in Article 1.09 of this Section.
- H. Ensure compatibility of total paint system for each substrate. Test shop primed equipment delivered to the site for compatibility with final paint system. Provide an acceptable barrier coat or totally remove shop applied paint system when incompatible with system specified, and repaint with specified paint system.
- I. The Contractor shall obtain all permits, licenses and inspections and shall comply with all laws, codes, ordinances, rules and regulations promulgated by authorities having jurisdiction which may bear on the work. This compliance will include Federal Public Law 91-596 more commonly known as the "Occupational Safety and Health Act of 1970".

1.03 REFERENCE SPECIFICATION, CODES AND STANDARDS

- A. Without limiting the generality of these specifications the Work shall conform to the applicable requirements of the following documents:
 - 1. SSPC - The Society for Protective Coatings Standards
 - a. SSPC-Vis 1 Pictorial Surface Preparation Standards for Painting Steel Structures
 - b. SSPC-SP2 Hand Tool Cleaning
 - c. SSPC-SP3 Power Tool Cleaning
 - d. SSPC-SP5 (NACE No. White Metal Blast Cleaning
 - e. SSPC-SP6 (NACE No. Commercial Blast Cleaning
 - f. SSPC-SP10 (NACE No. Near-White Metal Blast
 - g. SSPC-SP13 (NACE No. 6) Surface Preparation of Concrete
 - 2. NACE - National Association of Corrosion Engineers

3. ASTM D1737 - Test Method for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus
4. ASTM B117 - Method of Salt Spray (Fog) Testing
5. ASTM D4060 - Test Method for Abrasion Resistance of Organic Coating by the Taber Abraser
6. ASTM D3359 - Method for Measuring Adhesion by Tape Test

1.04 MANUFACTURERS

- A. All painting materials shall be as manufactured by Tnemec, Carboline, Sherwin Williams, or equal.

1.05 SUBMITTALS

- A. The Contractor shall submit paint manufacturer's data sheets, application instructions, and samples of each finish and color to the Engineer for review, before any work is started in accordance with Section 01300 entitled, "Submittals."
- B. Submitted samples of each finish and color shall be prepared in a step-down format so that the area of each sample indicates the appearance of the various coats. For example, where a three-coat system is specified, the sample shall be divided into three areas indicating one coat only, two coats and all three coats. The Engineer will provide written authorization constituting a standard, as to color and finish only, for each coating system.
- C. The Contractor shall prepare a complete schedule of surfaces to be coated and shall identify the surface preparation and paint system proposed for use. The Paint Schedule shall be in conformance with Article 3.03 of this Section. The schedule shall contain the name of the paint manufacturer, and the name, address and telephone number of the manufacturer's representative that will inspect the Work. The schedule shall be submitted to the Engineer for review as soon as possible following the Notice to Proceed so that the schedule may be used to identify colors and to specify shop painting systems on order for fabricated equipment.
- D. Name and detailed qualifications of the protective coating applicator or subcontractor. Qualifications shall include, but not be limited to, five (5) project references which show that the painting applicator or subcontractor has previous successful experience with the specified or comparable coating systems, a list of installations that are currently in service and documentation that applicator or subcontractor is currently a qualified applicator of the proposed coatings by the manufacturer. Include the name, address and telephone number of the owner of each installation for which the coating applicator provided the coating.

1.06 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall purchase paint from an acceptable manufacturer. The manufacturer shall assign a representative to inspect the application of his product both in the shop and field. The Contractor, through the manufacturer's representative, shall submit his report to the Engineer at the completion of his Work identifying the

products used and verifying that said products were properly applied and that the paint systems were proper for the exposure and service.

- B. Services shall also include, but not be limited to, inspecting prior coatings of paint, determination of best means of surface preparation, inspection of complete work, and re-inspection of painted work to be performed six months after the job is completed.

1.07 MANUFACTURER'S INSTRUCTIONS

- A. The manufacturer's published instructions for use as a guide in specifying and applying the manufacturers proposed paint shall be submitted to the Engineer. Paint shall not be delivered to the job before acceptance of the manufacturer's instructions is given by the Engineer.
- B. A manufacturer's paint will not be considered for use unless that manufacturer's published instructions meets the following requirements:
 - 1. The instructions must have been written and published by the manufacturer for the purpose and with the intent of giving complete instruction for the use and application of the proposed paint in the locality and for the conditions for which the paint is specified or shown to be applied under this Contract.
 - 2. All limitations, precautions, and requirements that may adversely affect the paint; that may cause unsatisfactory results after the painting application; or that may cause the paint not to serve the purpose for which it was intended; that is, to protect the covered material from corrosion, shall be clearly and completely stated in the instructions. These limitations and requirements shall, if they exist, include, but not be limited to the following:
 - a. Methods of application
 - b. Number of coats
 - c. Thickness of each coat
 - d. Total thickness
 - e. Drying time of each coat, including primer
 - f. Primer required to be used
 - g. Primers not permitted
 - h. Use of a primer
 - i. Thinner and use of thinner
 - j. Temperature and relative humidity limitations during application and after application
 - k. Time allowed between coats
 - l. Protection from sun
 - m. Physical properties of paint including solids content and ingredient analysis

- n. Surface preparation
 - o. Touch up requirements and limitations
- C. Concrete surfaces specified by the paint manufacturer to be acid etched shall be etched in accordance with the manufacturer's instructions. The surface shall then be thoroughly scrubbed with clean water, rinsed, and allowed to dry. The surface shall be tested with a moisture meter to determine when dry before coating. The surface shall also be tested for pH to determine the acid has been properly neutralized.

1.08 QUALITY ASSURANCE

- A. The Contractor shall give the Engineer a minimum of three days advance notice of the start of any field surface preparation work of coating application work.
- B. All such Work shall be performed only in the presence of the Engineer, unless the Engineer has specifically allowed the performance of such Work in his absence.
- C. Review by the Engineer, or the waiver of review of any particular portion of the Work, shall not relieve the Contractor of his responsibility to perform the Work in accordance with these Specifications.
- D. The Contractor shall provide references of the coating applicator or subcontractor per article 1.05, D.

1.09 SAFETY AND HEALTH REQUIREMENTS

- A. In accordance with requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions, appropriate technical bulletins, manuals, and material safety data sheets, the Contractor shall provide and require use of personnel protective and safety equipment for persons working in or about the project site.
- B. Respirators shall be worn by persons engaged or assisting in spray painting. The Contractor shall provide ventilating equipment and all necessary safety equipment for the protection of the workmen and the work.
- C. All paint shall comply with all requirements of the Air Pollution Regulatory Acts concerning the application and formulation of paints and coatings for an area in which the paints are applied. Specifically, paints shall be reformulated as required to meet the local, State and Federal requirements.

1.10 SURFACES NOT TO BE COATED

- A. The following items shall not be coated unless otherwise noted:
 - 1. Encased piping or conduit.
 - 2. Stainless steel work.
 - 3. Clear PVC secondary containment piping.
 - 4. Galvanized checkered plate.

5. Aluminum handrails, walkways, windows, louvers, grating and checkered plate.
6. Flexible couplings, lubricated bearing surfaces and insulation.
7. Packing glands and other adjustable parts of mechanical equipment.
8. Finish hardware.
9. Steel encased in concrete or masonry
10. Plastic switch plates and receptacle plates.
11. Signs and nameplates.
12. Any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.
13. Any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise indicated.

1.11 QUALITY WORKMANSHIP

- A. The Contractor shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect work whenever such covering is necessary, or if so requested by the City. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage occurs, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lapmarks and without additional cost to the City.
- B. Painting found defective shall be scraped or sandblasted off and repainted as the City may direct. Before final acceptance of the work, damaged surfaces of paint shall be cleaned and repainted as directed by the City.

1.12 ADDITIONAL PAINT

- A. At the end of the project, the Contractor shall turn over to the City a one gallon can (single component material) or small kit (multi component material – minimum of one gallon yield) of each type and color of paint, primer, thinner or other coating used in the field painting. The material shall be delivered in unopened, labeled cans as it comes from the factory. The manufacturer's literature describing the materials and giving directions for their use shall be furnished in three bound copies. A type-written inventory list shall be furnished at the time of delivery.

1.13 SHIPPING, HANDLING AND STORAGE

- A. All painting materials shall be brought to the job site in the original sealed labeled containers of the paint manufacturer and shall be subject to review by the Engineer. Where thinning is necessary, only the product of the manufacturer furnishing the paint shall be used. All such thinning shall be done strictly in accordance with the manufacturer's instructions, and with the full knowledge of the Engineer.

- B. Materials and their storage shall be in full compliance with the requirements of pertinent codes and fire regulations. Receptacles shall be placed outside buildings for paint gates and containers. Paint waste shall not be disposed of in plumbing fixtures, process drains or other plant systems or process units.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Table 09900-1 depicts the coatings referenced in Article 3.03 of this Section entitled, "Paint Schedule".

**TABLE 09900-1
PRODUCT LISTING**

Ref. No.	Description	Manufacturer's Reference		
		Tnemec	Carboline	Sherwin-Williams
101	Waterborne Polyamine Epoxy	151-1051 ElastoGrip FC	Sanitile 120	Loxon Conditioner
102	Water Based Block Filler	1254 Epoxoblock WB	Sanitile 100	Corobond 300
103	Modified Polyamidoamine Epoxy	135 – Color	Carboguard 890 – Color	Macropoxy 646
104	Polyamidoamine Epoxy Primer	N69 – 1211	Carboguard 890 – 0500	Macropoxy 646
105	Polyamidoamine Epoxy	N69 – Color	Carboguard 890 – Color	Macropoxy 646
107	Waterborne Acrylic Epoxy	113-Color	Sanitile 255 – Color	Hi-Bild WB Catalyzed Epoxy
110	Aliphatic Acrylic Polyurethane	1095 – Color	Carbothane 133HB – Color	Acrolon Ultra
111	Modified Waterborne Acrylate	156 - Envirocrete (Smooth Texture)	Flexxide Elastomer	Loxon XP
114	Acrylic Concrete Primer	6 Tneme-Cryl	Sanitile 120	Loxon Conditioner
115	Aromatic Urethane / Epoxy Zinc Rich	90-97 Tneme-Zinc	Carbozinc 859	Corothane I Galvapac
116	Water repellent	668 Chemprobe Deck A Pell 40	Carbocrete Sealer WB	H&C SL-40
118	Epoxy Modified Cementitious Mortar	218 MortarClad	Carboguard 510 SG	Corobond 300
119	Cycloaliphatic Amine Epoxy	104 H.S. Epoxy	Carboguard 893 (Non-immersion) Phenoline 385 (Immersion)	Tank Clad HS
131	Modified Polyamine	201 Epoxoprime	Carboguard 1340	Corobond 100

Ref. No.	Description	Manufacturer's Reference		
		Tnemec	Carboline	Sherwin-Williams
	Epoxy Primer			
132	Fiber Reinforced Polyamine Epoxy	270 Stranlok	Sanitile 755	Cor-Cote HCR Clear with 1 oz. glass mat
133	Polyamine Novolac Epoxy	282 Tneme-Glaze	Sanitile 949	Cor-Cote HCR FF
137	Silicate Blend	629 CT Densifyer	Carbocrete Sealer WB	H&C Clear Liquid Hardener & Densifyer
138	Aromatic Urethane / Novolac Epoxy Primer	1 Omnithane	Phenoline 311	Corothane I Galvapak 1K
139	Modified Polyamine Epoxy / Phenalkamine Epoxy	435 Perma-Glaze	Carboguard 690	Cor-Cote SC Coating

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. General

1. Surfaces to be painted shall be clean and dry, and free of dust, rust, scale and all foreign matter. No solvent cleaning, power or hand tool cleaning shall be permitted unless acceptable to the Engineer or specified herein.
2. Threaded portions of valve and gate stems, machined surfaces which are limited for sliding contact, surfaces which are to be assembled against gaskets, surfaces or shafting on which sprockets are to fit, or which are intended to fit into bearings, machined surfaces of bronze trim on slide gates and similar surfaces shall be masked off to protect them from the sandblasting of adjacent surfaces. Cadmium-plated or galvanized items shall not be sandblasted unless hereinafter specified, except that cadmium-plated, zinc-plated, or sherardized fasteners used in assembly of equipment to the sandblasted shall be sandblasted in the same manner as the unprotected metal. All installed equipment, mechanical drives, and adjacent painted equipment shall be protected from sandblasting. Protection shall prevent any sand or dust from entering the mechanical drive units or equipment where damage could be caused.
3. Hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place prior to cleaning and painting, and not intended to be painted, shall be protected or removed during painting operations and repositioned upon completion of painting operations.
4. Examine surfaces to be coated to determine that surfaces are suitable for specified surface preparation and painting. Report to Engineer surfaces found to be unsuitable in writing. Do not start surface preparation until unsuitable surfaces

have been corrected. Starting surface preparation precludes subsequent claim that such surfaces were unsuitable for the specified surface preparation or painting.

5. Surface preparation shall be in accordance with specifications and manufacturer's recommendations. Provide additional surface preparation, and fill coats where manufacturer recommends additional surface preparation, in addition to requirements of specification.
6. Touch-up shop or field applied coatings damaged by surface preparation or any other activity, with the same shop or field applied coating; even to the extent of applying an entire coat when required to correct damage prior to application of the next coating. Touch up coats are in addition to the specified applied systems, and not considered a field coat.
7. Protect motors and other equipment during blasting operation to ensure blasting material is not blown into motors or other equipment. Inspect motors and other equipment after blasting operations and certify that no damage occurred, or where damage occurred, the proper remedial action was taken
8. Sand from sandblasting shall be thoroughly removed, using a vacuum cleaner if necessary. No surface which has been sandblasted shall be painted until inspected by the Engineer.

B. Metal Surfaces

1. Except as otherwise provided, all preparation of metal surfaces shall be in accordance with Specifications SP-1 through SP-10 of the Society for Protective Coatings (SSPC). Where the Society for Protective Coatings Specifications are referred to in these Contract Documents, the corresponding Pictorial Surfaces Preparation Standard shall be used to define the minimum final surface conditions to be supplied. Grease and oil shall be removed and the surface prepared by hand tool cleaning, power tool cleaning or blast cleaning in accordance with the appropriate Specification SP-1 through SP-30.
2. Perform blast cleaning operations for metal when following conditions exist:
 - a. Moisture is not present on the surface.
 - b. Relative humidity is below 80%.
 - c. Ambient and surface temperatures are 5°F or greater than the dew point temperature.
 - d. Painting or drying of paint is not being performed in the area.
 - e. Equipment is in good operating condition.
 - f. Proper ventilation, illumination, and other safety procedures and equipment are being provided and followed.
3. Weld flux, weld spatter and excessive rust scale shall be removed by power tool cleaning as per SSPC-SP-3.

4. All ferrous metal surfaces not required to be galvanized shall be cleaned of all oil grease, dirt, rust and tight and loose mill scale by blasting in accordance with the following: SSPC SP 5 White Metal Blast Cleaning and comply with the visual standard NACE No. 1, for shop prepared and shop primed metal to be submerged or in a corrosive environment, SSPC-SP10 Near White Metal Blast Cleaning, and comply with the visual standard NACE No. 2 for field prepared metal to be submerged or in a corrosive environment, SSPC-SP6 and comply with the visual standard NACE No. 3 for metal in all other locations. Pickling, complying with SSPC SP 8, may be substituted for Near White Blast in areas as determined by the Engineer. Priming shall follow sandblasting before any evidence of corrosion occurs, before nightfall and before any moisture is on the surface.
5. Field surface preparation of small, isolated areas such as field welds, repair of scratches, abrasions or other marks to the shop prime or finish shall be cleaned by power tools in accordance with SSPC SP 3, or in difficult and otherwise inaccessible areas by hand cleaning in accordance with SSPC SP 2 and spot primed.
6. All coated surfaces shall be cleaned prior to application of successive coats. All non ferrous metals not to be coated shall be cleaned. This cleaning shall be done in accordance with SSPC SP 1, Solvent Cleaning.
7. All shop coated surfaces shall be protected from damage and corrosion before and after installation by treating damaged areas immediately upon detection. Abraded or corroded spots on shop coated surfaces shall be prepared in accordance with SSPC SP 2, Hand Tool Cleaning and then touched up with the same materials as the shop coat.
8. All shop coated surfaces which are faded, discolored, or which require more than minor touch up, in the opinion of the Engineer, shall be repainted. Cut edges of galvanized sheets, electrical conduit, and metal pipe sleeves, not to be finish painted, shall be cleaned in accordance with SSPC SP 1, Solvent Cleaning and primed with zinc dust zinc oxide metal primer.

C. Concrete Surfaces

1. Concrete surfaces are to be cured for at least 28 days prior to surface preparation, unless coatings are recommended for application over green concrete surfaces.
2. Test concrete for moisture content, pH and salts using test method recommended by the paint manufacturer. Do not begin surface preparation, or painting until moisture content is acceptable to manufacturer.
3. Non-submerged concrete and masonry surfaces to be painted shall be prepared by removing efflorescence, chalk, dust, dirt, grease, oil, form coating, tar and by roughening to remove glaze. All surfaces shall be repaired prior to commencement of the coating operation.
4. Concrete immersion surfaces that are to be coated shall be prepared in accordance to SSPC-SP13/NACE No. 6 to remove all laitance, curing compounds, hardeners, sealers, and other contaminants, and to provide a minimum surface profile. Refer to manufacturer's recommendation for specific coating being applied and adhere to ICRI Concrete Surface Preparation Profiles (CSP 1-10) when reviewing concrete

surface preparation. Areas of concrete which contain bug holes or voids shall be filled with the manufacturer's approved filler material.

D. Masonry

1. Cure for a minimum of 28 days prior to surface preparation or paint application.
2. Clean masonry surfaces free from all dust, dirt, oil, grease, loose mortar, chalky deposits, efflorescence, and other foreign materials.
3. Test masonry for moisture content. Use test method recommended by paint manufacturer. Do not begin painting until moisture content is acceptable to manufacturer.

E. Wood

1. Clean wood surfaces free of all foreign matter, with cracks and nail holes and other defects properly filled and smoothed. Remove sap and resin by scraping and wipe clean with rags dampened with mineral spirits.
2. Saturate end grain, cut wood, knots, and pitch pockets with an appropriate sealer before priming.
3. Prime and backprime wood trim before setting in place.
4. After prime coat has dried, fill nailholes, cracks, open joints, and other small holes with approved spackling putty. Lightly sand wood trim prior to applying second coat of paint.

F. Exposed Pipe, Valves and Pumps

1. Bituminous coated pipe shall not be used in exposed locations. Pipe which shall be exposed after project completion shall be primed in accordance with the requirements herein. Any bituminous coated ferrous pipe which is inadvertently installed in exposed locations shall be sandblasted to SSPC SP 5 White Metal before priming and painting.
2. After installation and prior to finish painting, all exterior, exposed flanged joints shall have the gap between adjoining flanges and gaps between the pipe wall and threaded-on flanges sealed with a single component Thiokol caulking to prevent rust stains.

G. Gypsum Drywall

1. Sand joint compound with sandpaper to provide a smooth flat surface. Avoid sanding of adjacent drywall paper.
2. Remove dust, dirt, and other contaminants.

H. PVC Pipe Surfaces

1. All pipe surfaces shall be cleaned and lightly sanded before painting.

I. Existing Painted Surfaces

1. Totally remove existing paint when: surface is to be submerged in a severe environment, paint is less than 75% intact, brittle, eroded or has underfilm rusting.
2. Surfaces which are greater than 75% intact require removal of failed paints and then spot primed. Spot priming is in addition to coats specified.
3. Remove surface contamination such as oil, grease, loose paint, mill scale, dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers.
4. Clean and dull glossy surfaces prior to painting in accordance with the manufacturer's recommendations.
5. Check existing paints for compatibility with new paint system. If incompatible, totally remove existing paint system or apply a barrier coat recommended by the paint manufacturer. Remove existing paints of undetermined origin. Prepare a test patch of approximately 3 square feet over existing paint. Allow test patch to dry thoroughly and test for adhesion. If proper adhesion is not achieved remove existing paint and repaint.

3.02 SHOP PAINTING

- A. All fabricated steel work and equipment shall receive at the factory at least one shop coat of prime paint compatible with the paint system required by these Specifications. The Contractor shall coordinate all shop priming to ensure compatibility with paint system specified. Surface preparation prior to shop painting shall be as specified herein. Finish coats may be applied in the shop if acceptable to the Engineer. All shop painted items shall be properly packaged and stored until they are incorporated in the Work. Any painted surfaces that are damaged during handling, transporting, storage or installation shall be cleaned, scraped, and patched before field painting begins so that Work shall be equal to the original painting received at the shop. Equipment or steel Work that is to be assembled on the site shall likewise receive a minimum of one shop coat of paint at the factory. Surfaces of exposed members that will be inaccessible after erection shall be prepared and painted before erection.
- B. The Contractor shall specify the shop paints to be applied when ordering equipment in order to assure compatibility of shop paints with field paints. The paints and surface preparation used for shop coating shall be identified on shop drawings submitted to the Engineer for review. Shop paint shop drawings will not be reviewed until the final project paint system has been submitted by the Contractor and reviewed by the Engineer.
- C. Shop finish coats may be the standard finish as ordinarily applied by the manufacturer if it can be demonstrated to the Engineer that the paint system is equal to and compatible with the paint system specified. However, all pumps, motors and other equipment shall receive at least one field applied finish coat after installation.

3.03 PAINT SCHEDULE

- A. The Contractor shall adhere to this paint schedule, providing those paints named or equal. DFT shall mean the minimum dry film thickness per application measured in mils. Products are referenced by numbers listed in table 09900-1 in Article 2.01 of this Section entitled "Product Listing." The paint schedule identifies the minimum DFT required per coat. If the Contractor does not achieve the specified DFT range in a

single coat, he shall provide additional coats as necessary at no additional cost to the City.

B. Metal Surfaces, Atmospheric (Exterior) Exposure

1. Metal surfaces exposed to the atmosphere that do not come into contact with wastewater or corrosive atmosphere including the following types of surfaces shall be painted as described below:

- a. Pumps, motors, process equipment, machinery, etc.
- b. Above ground piping, valves and pipe supports.
- c. Miscellaneous steel shapes, angles, etc.
- d. Exposed surfaces of conduit, ductwork, etc.

Ferrous Metal

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	104	Polyamidoamine Epoxy Primer	3.0 - 5.0
Second - 1 coat (*)	105	Polyamidoamine Epoxy	2.0 - 3.0
Finish - 1 coat	110	Aliphatic Acrylic Urethane	<u>3.0 - 4.0</u>
Min. Total			10.0 MILS

(*) Broadcast 50 mesh silica sand while still wet over entire digester cover area.

Non-Ferrous Metal

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	105	Polyamidoamine Epoxy	2.0 - 3.0
Second - 1 coat	110	Aliphatic Acrylic Urethane	<u>3.0 - 4.0</u>
Min. Total			6.0 MILS

Galvanized

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
Spot Repair	115	Aromatic Urethane / Epoxy Zinc-Rich (spot)	2.5 - 3.5
First - 1 coat	105	Polyamidoamine Epoxy	2.0 - 3.0
Second - 1 coat	110	Aliphatic Acrylic Urethane	<u>3.0 - 4.0</u>
Min. Total			6.0 MILS

C. Metal Surfaces, Submerged Exposure

1. Metal surfaces that are submerged shall be painted as described below:

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
Stripe coat	119	Cycloaliphatic Amine Epoxy	3.0 – 5.0
First – 1 coat	119	Cycloaliphatic Amine Epoxy	4.0 – 6.0

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Finish - 1 coat	119	Cycloaliphatic Amine Epoxy	<u>4.0 – 6.0</u>
		Min. Total (excluding stripe coat)	10.0 Mils

D. Metal Surfaces, Interior Exposure

1. Interior metal surfaces (nonsubmerged) that do not come in contact with wastewater or the corrosive atmosphere including the following types of surfaces shall be painted as follows:

- a. Pumps, motors, process equipment, machinery, etc.
- b. Piping, valves and supports.
- c. Miscellaneous steel shapes, angles, rails, etc.
- d. Exposed surfaces of conduit, ductwork, etc.

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	104	Polyamidoamine Epoxy Primer	3.0 - 5.0
Finish - 1 coat	105	Polyamidoamine Epoxy	<u>4.0 - 6.0</u>
		Min. Total	9.0 Mils

E. Ductile Iron Pipe, Exterior or Interior Exposure

1. Ductile iron pipe exterior or interior exposure shall receive the following types of paint:

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	105	Polyamidoamine Epoxy	6.0 - 10.0
Finish - 1 coat	110	Aliphatic Acrylic Polyurethane	<u>3.0 - 5.0</u>
		Min. Total	12.0 Mils

F. PVC Pipes, Exterior or Interior Exposure

1. PVC pipes, valves, and accessories, shall receive the following types of paint:

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	105	Polyamidoamine Epoxy	2.0 - 3.0
Finish - 1 coat	110	Aliphatic Acrylic Polyurethane	<u>3.0 - 4.0</u>
		Min. Total	6.0 Mils

G. New Concrete, Masonry and Stucco, Exterior Exposure

- 1. The exterior above grade concrete, masonry, and stucco surfaces of all new structures shall receive the following:
- 2. Surface preparation: Surface shall be clean and dry without efflorescence, chalk, dust, dirt, grease, oil, form coating, and tar. Allow concrete to cure for 28 days.

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
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PROJECT NO. 11843 PROGRESSO VILLAGE STORM WATER IMPROVEMENTS

Block Filler (*)	102	Water Based Epoxy Block Filler	100-150 SF/Gal
Primer (**)	114	Acrylic Concrete Primer	300-400 SF/Gal
First - 1 coat	111	Modified Waterborne Acrylate	4.0 - 6.0
Finish - 1 coat	111	Modified Waterborne Acrylate	<u>4.0 - 6.0</u>
		Min. Total	10.0 Mils

(*) Block filler only to be used on new CMU

(**) Concrete primer for non-CMU applications

H. New Concrete and Masonry Surfaces, Interior Exposure

- Interior exposed masonry and concrete wall and ceiling surfaces, including beam and column surfaces of all new non-water retaining structures shall be painted as follows:
- Surface preparation: Surface shall be clean and dry without efflorescence, chalk, dust, dirt, grease, oil, form coating, and tar. Allow concrete to cure for 28 days.

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
Block Filler (*)	102	Water Based Epoxy Block Filler	100-150 SF/Gal
Primer (**)	114	Acrylic Concrete Primer	300-400 SF/Gal
First - 1 coat	105	Polyamidoamine Epoxy	4.0 - 6.0
Finish - 1 coat	105	Polyamidoamine Epoxy	<u>4.0 - 6.0</u>
		Min. Total	10.0 Mils

*Block Filler shall only be used on new masonry.

** Concrete primer for non-CMU applications

I. Gypsum Wallboard Surfaces

- All exposed gypsum board shall be painted as follows:

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 coat	101	Waterborne Polyamine Epoxy	1.0 - 2.0
Second - 1 coat	107	Waterborne Acrylic Epoxy	2.0 - 3.0
Finish - 1 coat	107	Waterborne Acrylic Epoxy	<u>2.0 - 3.0</u>
		Minimum Total	6.0 Mils

J. Concrete Floor Surfaces of Electrical Rooms

- Concrete floor surfaces of electrical rooms shall be painted as follows:

<u>Application</u>	<u>No.</u>	<u>Description</u>	<u>DFT</u>
First - 1 Coat	137	Silicate Blend	300 SF/Gal
Finish - 1 coat	137	Silicate Blend	350 SFT/Gal

3.04 PAINTING

- A. Application: All paint shall be applied by experienced painters with brushes or other applicators acceptable to the Engineer.
1. Paint shall be applied without runs, sags, thin spots, or unacceptable marks. Paints shall be applied at the rate specified by the manufacturer to achieve the minimum dry mil thickness required. Additional coats of paint shall be applied, if necessary, to obtain thickness specified.
 2. Paint shall be applied with spraying equipment only on those surfaces approved by the Engineer. If the material has thickened or must be diluted for application by spray gun, each coat shall be built up to the same film thickness achieved with undiluted brushed on material. Where thinning is necessary, only the products of the particular manufacturer furnishing the paint shall be used; and all such thinning shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the Engineer.
 3. Surfaces not accessible to brushes or rollers may be painted by spray by dauber or sheepskins and paint mitt. If any of these methods is to be used, it shall be done in strict accordance with the manufacturer's instructions, as well as with the full knowledge of the Engineer.
- B. Drying Time: A minimum of twenty four hours drying time shall elapse between applications of any two coats of paint on a particular surface unless shorter time periods are a requirement of the manufacturer or specified herein. Longer drying times shall be required for abnormal conditions as defined by the manufacturer.
- C. Weather Restrictions: No painting whatsoever shall be accomplished in rainy or excessively damp weather when the relative humidity exceeds 85 percent, or when the general air temperature cannot be maintained at 50 degrees Fahrenheit or above throughout the entire drying period. No paint shall be applied when it is expected that the relative humidity will exceed 85 percent or that the air temperature will drop below 50 degrees Fahrenheit within 18 hours after the application of the paint.
1. Dew or moisture condensation should be anticipated; and if such conditions are prevalent, painting shall be delayed until midmorning to be certain the surfaces are dry. The day's painting shall be completed well in advance of the probable time of day when condensation will occur.
- D. Inspection of Surfaces
1. Surface preparation and every field coat of priming and finishing paint shall be inspected by the Engineer or his authorized representative before the succeeding coat is applied. The Contractor shall follow a system of tinting successive paint coats so that no two coats for a given surface are exactly the same color. Areas to receive black protective coatings shall in such cases be tick marked with white or actually gauged as to thickness when finished.
 2. Before application of the prime coat and each succeeding coat, any defects or deficiencies in the prime coat or succeeding coat shall be corrected by the Contractor before application of any subsequent coating.

3. Samples of surface preparation and of painting systems shall be furnished by the Contractor to be used as a standard throughout the job, unless omitted by the Engineer.
4. When any appreciable time has elapsed between coatings, previously coated areas shall be carefully inspected by the Engineer, and where, in his opinion, surfaces are damaged or contaminated, they shall be cleaned and recoated at the Contractor's expense. Recoating times of manufacturer's printed instructions shall be adhered to.
5. Coating thickness shall be verified by the use of a dry film thickness digital gauge. Gauge shall be Elcometer 456 or equal and shall be properly calibrated. Coating thickness on non-metal surfaces shall be verified by the use of an ultrasonic gauge. Ultrasonic gauge shall be Positector 200 or equal. Gauges shall include the entire range of coating thicknesses required in this section.
6. The Contractor shall provide free of charge to the Engineer two new digital dry film gauges and two wet film gauges to be used to inspect coating by Engineer and Contractor. One gauge may be used by Contractor and returned each day to the Engineer. Engineer will return gauges to Contractor at completion of job.
7. Coatings shall pass a holiday detector test.
8. Determination of Film Thickness: Randomly selected areas, each of at least 107.5 contiguous square feet, totaling at least 5% of the entire control area shall be tested. Within this area, at least 5 squares, each of 7.75 square inches, shall be randomly selected. Three readings shall be taken in each square, from which the mean film thickness shall be calculated. No more than 20 percent of the mean film thickness measurements shall be below the specified thickness. No single measurement shall be below 80 percent of the specified film thickness. Total dry film thickness greater than twice the specified film thickness shall not be acceptable. Areas where the measured dry film thickness exceeds twice that specified shall be completely redone unless otherwise approved by the Engineer. When measured dry film thickness is less than that specified additional coats shall be applied as required.
9. Holiday Testing: Holiday test painted ferrous metal surfaces which will be submerged in water or other liquids, or surfaces which are enclosed in a vapor space in such structures. Mark areas which contain holidays. Repair or repaint in accordance with paint manufacturer's printed instructions and retest.
 - a. Dry Film Thickness Exceeding 20 Mils: For surfaces having a total dry film thickness exceeding 20 mils: Pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 - b. Dry Film Thickness of 20 Mils or Less: For surfaces having a total dry film thickness of 20 mils or less: Tinker & Razor Model M1 non-destructive type holiday detector, K-D Bird Dog, shall be used. The unit shall operate at less than 75-volts. For thicknesses between 10 and 20 mils, a non-sudsing type

wetting agent, such as Kodak Photo-Flow, shall be added to the water prior to wetting the detector sponge.

E. Special Areas

1. All surfaces which are to be installed against concrete, masonry etc., and will not be accessible for field priming and/or painting shall be back primed and painted as specified herein, before erection. Anchor bolts shall be painted before the erection of equipment and then the accessible surfaces repainted when the equipment is painted.

F. Special attention shall be given to insure that edges, corners, crevices, welds and rivets receive a film thickness equivalent to that of the adjacent painted surfaces.

G. Safety

1. Respirators shall be worn by persons engaged or assisting in spray painting. The Contractor shall provide ventilating equipment and all necessary safety equipment for the protection of the workmen and the Work.

H. Quality Workmanship

1. The Contractor shall be responsible for the cleanliness of his painting operations and shall use covers and masking tape to protect the Work whenever such covering is necessary, or if so requested by the City. Any unwanted paint shall be carefully removed without damage to any finished paint or surface. If damage does occur, the entire surface, adjacent to and including the damaged area, shall be repainted without visible lap marks and without additional cost to the City.

I. Painting found defective shall be scraped or sandblasted off and repainted as the Engineer may direct. Before final acceptance of the Work, damaged surfaces of paint shall be cleaned and repainted as directed by the Engineer.

J. Any pipe scheduled to be painted and having received a coating of a tar or asphalt compound shall be painted with two coats or "Intertol Tar Stop", "Tnemec Tar Bar" or equal before successive coats are applied in accordance with the paint schedule.

3.05 SCHEDULE OF COLORS

- A. All colors shall be as designated by the Engineer at the shop drawing review. The Contractor shall submit color samples including custom color choices as required to the Engineer as specified in Article 1.05 of this Section. The Contractor shall submit suitable samples of all colors and finishes for the surfaces to be painted, or on portable surfaces when required by the Engineer. The Engineer shall decide upon the choice of colors and other finishes when alternates exist. No variation shall be made in colors without the acceptance from the City. Color names and/or numbers shall be identified according to the appropriate color chart issued by the manufacturer of the particular product in question.
- B. All above ground water main piping shall be painted white with blue longitudinal striping.
- C. All underground water main piping shall have continuous 4" blue longitudinal stripe.

D. All above ground force main piping shall be painted green.

3.06 COLOR CODING AND LETTERING OF PIPING

A. The Contractor shall paint all piping, valves, equipment, exposed conduits and all appurtenances which are integral to a complete functional mechanical pipe and electrical conduit system, in accordance with Table 09900-2 entitled "Pipe Color Coding Schedule". Where colors are not designated for piping and conduit systems they will be selected during the shop drawing review from the paint manufacturer's standard color charts.

B. In general, the pumps and equipment shall be painted the same color as the piping system to which it is connected unless otherwise directed by the Engineer. Where colors are not designated for piping and conduit systems they will be selected during the shop drawing review from the paint manufacturer's standard color charts.

C. Lettering of Piping

1. The Contractor shall apply identification titles and arrows indicating the direction of flow of liquids to all types and sections of all new and existing plant piping. Titles shall be as directed by the Engineer. Identification titles shall be located midway between color coding bands where possible. Identification lettering and arrows shall be placed as directed by the Engineer, but shall generally be located each fifteen feet in pipe length and shall be properly inclined to the pipe axis to facilitate easy reading. Titles shall also appear directly adjacent to each side of any wall or slab the pipeline passes through.

D. The titles shall be painted by use of stencils and shall identify the contents by complete names at least once in each area through which it passes and thereafter be abbreviated. Stencils shall be provided for titles and abbreviations listed in Table 09900-3.

E. Title color shall be black or white as directed and shall have an overall height in inches in accordance with Table 09900-4. Letter type shall be Helvetica Medium upper case. The manufacturer's instructions shall be followed in respect to storage, surface preparation and application. For piping less than 3/4-inch diameter (as identified in Table 09850-2), the Contractor shall furnish and attach corrosion resistant color tags with the required lettering.

F. Banding

1. Where bands are indicated in the Pipe Color Coding Schedule, the pipe is to be painted for its full circumference with a band of the color indicated. The bands shall be six inches wide, neatly made by masking, and spaced eight feet apart. The Contractor may substitute precut prefinished bands on piping subject to acceptance by the Engineer. Where banded pipes are running concurrently in a space, bands shall be located so that on adjacently located pipes, bands will be grouped beside each other.

3.07 OSHA SAFETY COLORS

A. Items listed in ANSI Z53.1-1971, Section 2.1 shall be painted ANSI Red. In general, these items shall include fire protection equipment and apparatus; wall mounted

breathing apparatus, danger signs and locations; and stop bars, buttons or switches. In addition all hose valves and riser pipes, fire protection piping and sprinkler systems, and electrical stop switches shall be painted ANSI Red.

- B. Items listed in ANSI Z53.1-1971, Section 2.3 shall be painted ANSI Yellow. Yellow shall be the basic color for designating caution and for marking physical hazards such as striking against, stumbling, falling, tripping, and "caught in between". In addition, an 8-inch wide strip on the top and bottom tread of stairways shall be coated.

3.08 WORK IN CONFINED SPACES

- A. The Contractor shall provide and maintain safe working conditions for all employees. Fresh air shall be supplied continuously to confined spaces through the combined use of existing openings, forced draft fans, or by direct air supply to individual workers. Paint fumes shall be exhausted to the outside from the lowest level in the contained space.
- B. Electrical fan motors shall be explosion proof if in contact with fumes. No smoking or open fires will be permitted in, or near, confined spaces where painting is being done.

3.09 CLEANING

- A. The buildings and all other Work area shall be at all times kept free from accumulation of waste material and rubbish caused by the Work. At the completion of the painting, all tools, equipment, scaffolding, surplus materials, and all rubbish around the inside the buildings shall be removed and the Work left broom clean unless otherwise specified.

**TABLE 09900-2
PIPE COLOR CODING SCHEDULE**

Equipment / Piping	Suggested Color
Stormwater	Green
Wastewater	Green
Potable Water	Blue
Emergency Shower Eyewash	Safety Yellow, BV57

**TABLE 09900-4
HEIGHT OF PIPING LETTERING**

<u>Diameter of Pipe or Pipe Covering</u>	<u>Height of Lettering</u>
3/4 to 1-1/4 inches	1/2 inch
1-1/2 to 2 inches	3/4 inch
2-1/2 to 6 inches	1-1/4 inches
8 to 10 inches	2-1/2 inches
Over 10 inches	3-1/2 inches

Notes:

1. Letter type shall be Helvetica Medium upper case. The manufacturer's instructions shall be followed in respect to storage, surface preparation and application.

END OF SECTION

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SECTION 10200
LOUVERS AND VENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Louvers and vents.

B. Related Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 07600 - Flashing and Roofing Accessories.
4. Section 07920 – Sealants and Caulking.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. Aluminum Association (AA):
 - a. DAF 45, Designation System for Aluminum Finishes.
2. Air Movement and Control Association (AMCA).
3. ASTM International (ASTM):
 - a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.03 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.
2. Drawing showing location of each louver or vent, indicating size and arrangement of blank-off plates if required.
3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.

- c. Color chart showing manufacturer's full line of colors including exotic and special colors for color selection by Engineer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Louvers:
 - a. Airlite Co.
 - b. Construction Specialties, Inc.
 - c. Ruskin Manufacturing.
 - d. Industrial Louvers, Inc.
 - e. American Warming.
- B. Submit request for substitution in accordance with Specification Section 01640.

2.02 MANUFACTURED UNITS

- A. Louvers:
 1. 4 IN deep.
 2. Drainable with blades at 37-1/2 DEG.
 3. Continuous blade appearance.
 4. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.081 IN thick.
 5. Minimum free area: 8.58 SQFT for 4 x 4 FT louver.
 6. Maximum pressure drop: 0.10 IN of water at 700 FPM.
 7. Water penetration: 0.01 OZ/SF at 873 FPM.
 8. AMCA certified.
 9. Ruskin "ELF 375DX".
 10. Insect screen:
 - a. 18-16 mesh aluminum.
 - b. Install in standard aluminum frame.
- B. Anchors, Fasteners, Reinforcing: Aluminum or stainless steel.
- C. Finish:

1. Architectural Class 1 coating per AA DAF 45.
 - a. AA-M12C22A41 clear anodized
- D. Size: Refer to Mechanical Drawings for louver size, and refer to Architectural Drawings for louver shapes.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchoring and bracing accessories as required.
- C. Seal around perimeter on exterior and interior.
 1. See Section 07920.
- D. Install 0.040 IN aluminum flashing at sill to match louver.
 1. See Section 07600.

END OF SECTION

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SECTION 10400
IDENTIFICATION DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar items, and hazard and safety signs.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society of Mechanical Engineers (ASME):
 - a. A13.1, Scheme for the Identification of Piping Systems.
2. The International Society of Automation (ISA).
3. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
 - a. Z535.1, Safety Color Code.
 - b. Z535.2, Environmental and Facility Safety Signs.
 - c. Z535.3, Criteria for Safety Symbols.
 - d. Z535.4, Product Safety Signs and Labels.
4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
5. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

1.03 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.

2. Product technical data including:
 - a. Catalog information for all identification systems.
 - b. Acknowledgement that products submitted meet requirements of standards referenced.
3. Identification register, listing all items in PART 3 of this Specification Section to be identified, type of identification system to be used, lettering, location and color.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. W.H. Brady Co.
 2. Panduit.
 3. Seton.
 4. National Band and Tag Co.
 5. Carlton Industries, Inc.
- B. Submit request for substitution in accordance with Specification Section 01640.

2.02 MANUFACTURED UNITS

- A. Type A1 - Round Metal Tags:
 1. Materials:
 - a. Aluminum or stainless steel.
 - b. Stainless steel shall be used in corrosive environments.
 2. Size:
 - a. Diameter: 1-1/2 IN minimum.
 - b. Thickness: 0.035 IN (20 GA) minimum.
 3. Fabrication:
 - a. 3/16 IN minimum mounting hole.
 - b. Legend: Stamped and filled with black coloring.
 4. Color: Natural.
- B. Type A2 - Rectangle Metal Tags:

1. Materials: Stainless steel.
 2. Size:
 - a. 3-1/2 IN x 1-1/2 IN minimum.
 - b. Thickness: 0.036 IN (20 GA) minimum.
 3. Fabrication:
 - a. 3/16 IN minimum mounting hole.
 - b. Legend: Stamped and filled with black coloring.
 4. Color: Natural.
- C. Type A3 - Metal Tape Tags:
1. Materials: Aluminum or stainless steel.
 2. Size:
 - a. Width 1/2 IN minimum.
 - b. Length as required by text.
 3. Fabrication:
 - a. 3/16 IN minimum mounting hole.
 - b. Legend: Embossed.
 4. Color: Natural.
- D. Type B1- Square Nonmetallic Tags:
1. Materials: Fiberglass reinforced plastic.
 2. Size:
 - a. Surface: 2 x 2 IN minimum.
 - b. Thickness: 100 mils.
 3. Fabrication:
 - a. 3/16 IN mounting hole with metal eyelet.
 - b. Legend: Preprinted and permanently embedded and fade resistant.
 4. Color:
 - a. Background: Manufacturer standard or as specified.
 - b. Lettering: Black.
- E. Type B2 - Nonmetallic Signs:

1. Materials: Fiberglass reinforced or durable plastic.
 2. Size:
 - a. Surface: As required by text.
 - b. Thickness: 60 mils minimum.
 3. Fabrication:
 - a. Rounded corners.
 - b. Drilled holes in corners with grommets.
 - c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
 4. Color:
 - a. Background: Manufacturer standard or as specified.
 - b. Lettering: Black.
 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- F. Type D - Self-Adhesive Tape Tags and Signs:
1. Materials: Vinyl tape or vinyl cloth.
 2. Size:
 - a. Surface: As required by text.
 - b. Thickness: 5 mils minimum.
 3. Fabrication:
 - a. Indoor/Outdoor grade.
 - b. Weather and UV resistant inks.
 - c. Permanent adhesive.
 - d. Legend: Preprinted.
 - e. Wire markers to be self-laminating.
 4. Color: White with black lettering or as specified.
 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- G. Type E - Heat Shrinkable Tape Tags:
1. Materials: Polyolefin.

2. Size: As required by text.
 3. Fabrication:
 - a. Legend: Preprinted.
 4. Color: White background, black printing.
- H. Type F - Underground Warning Tape:
1. Materials: Polyethylene.
 2. Size:
 - a. 6 IN wide (minimum).
 - b. Thickness: 3.5 mils.
 3. Fabrication:
 - a. Legend: Preprinted and permanently imbedded.
 - b. Message continuous printed.
 - c. Tensile strength: 1750 PSI.
 4. Color: As specified.
- I. Underground Tracer Wire:
1. Materials:
 - a. Wire:
 - 1) 12 GA AWG.
 - 2) Solid.
 - b. Wire nuts: Waterproof type.
 - c. Split bolts: Brass.

2.03 ACCESSORIES

- A. Fasteners:
1. Bead chain: #6 brass, aluminum or stainless steel.
 2. Plastic strap: Nylon, urethane or polypropylene.
 3. Screws: Self-tapping, stainless steel.
 4. Adhesive, solvent activated.

2.04 MAINTENANCE MATERIALS

- A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. Install identification devices at specified locations.
- B. All identification devices to be printed by mechanical process, hand printing is not acceptable.
- C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.
- D. Attach tags with 1/8 IN round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.
 - 1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.
- E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.
 - 1. Several items of equipment mounted in housing to be individually tagged inside the compartment.
- F. Tracer Wire:
 - 1. Attach to pipe at a maximum of 10 FT intervals with tape or tie-wraps.
 - 2. Continuous pass from each valve box and above grade at each structure.
 - 3. Coil enough wire at each valve box to extend wire a foot above the ground surface.
 - 4. 1,000 FT maximum spacing between valve boxes.
 - 5. If split bolts are used for splicing, wrap with electrical tape.
 - 6. If wire nuts are used for splicing, knot wire at each splice point leaving 6 IN of wire for splicing.
 - 7. Use continuous strand of wire between valve box where possible.
 - a. Continuous length shall be no shorter than 100 FT.

3.02 SCHEDULES

- A. Process Systems:
 - 1. General:
 - a. Provide arrows and markers on piping.

- 1) At 20 FT maximum centers along continuous lines.
 - 2) At changes in direction (route) or obstructions.
 - 3) At valves, risers, "T" joints, machinery or equipment.
 - 4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
- b. Position markers on both sides of pipe with arrow markers pointing in flow direction.
- 1) If flow is in both directions use double headed arrow markers.
- c. Apply tapes and stenciling in uniform manner parallel to piping.
2. Trenches with piping:
- a. Tag type: Type F - Underground Warning Tape
 - b. Location: Halfway between top of piping and finished grade.
 - c. Letter height: 1-1/4 IN minimum.
 - d. Natural gas or digester gas:
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED GAS LINE BELOW"
 - e. Potable water:
 - 1) Color: Blue with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED WATER LINE BELOW"
 - f. Storm and sanitary sewer lines:
 - 1) Color: Green with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED SEWER LINE BELOW"
 - g. (Nonpotable) water piping, except 3 IN and smaller irrigation pipe:

- 1) Color: Green with black letters.
- 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED NONPOTABLE WATER LINE BELOW"
- h. Chemical feed piping (e.g., chlorine solution, polymer solution, caustic solution, etc.):
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED CHEMICAL LINE BELOW"
- i. Other piping (e.g., compressed air, irrigation, refrigerant, heating water, etc.):
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED PIPE LINE BELOW"
3. Yard valves, buried, with valve box and concrete pad:
 - a. Tag type: Type A2 - Rectangle Metal Tags.
 - b. Fastener: 3/16 IN x 7/8 IN plastic screw anchor with 1 IN #6 stainless steel pan head screw.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
4. Valves and slide gates:
 - a. Tag type:
 - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
 - 2) Indoor noncorrosive:
 - a) Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - 3) Indoor corrosive:

- a) Stainless steel Type A1 - Round Metal Tags.
- b) Type B1 - Square Nonmetallic Tags.
- b. Fastener:
 - 1) Type A1: Chain of the same material.
 - 2) Type B1: Stainless steel chain.
- c. Color: Per ASME A13.1 corresponding to the piping system.
- d. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
- 5. Process equipment (e.g., pumps, pump motors, blowers, air compressors, bar screens, clarifier drive mechanism, etc.):
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type D - Self-Adhesive Tape Tags and Signs.
 - 3) Type G - Stenciling System.
 - b. Fastener:
 - 1) Self.
 - 2) Screws.
 - 3) Adhesive.
 - c. Legend:
 - 1) Letter height: 1/2 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "Primary Sludge Pump P-xxx").
- 6. Piping systems:
 - a. Tag type:
 - 1) Outdoor locations: Type G - Stenciling System.
 - 2) Indoor locations:
 - a) Type D - Self-Adhesive Tape Tags and Signs.
 - b) Type G - Stenciling System.

- b. Fastener: Self.
 - c. Color: Per ASME A13.1.
 - d. Legend:
 - 1) Letter height: Manufacturers standard for the pipe diameter.
 - 2) Mark piping in accordance with ASME A13.1.
 - 3) Use piping designation as indicated on the Drawings.
 - 4) Arrow: Single arrow.
7. Process tanks (over 1000 GAL) and basins, (e.g., chemical storage, clarifiers, trickling filters, digesters, etc):
- a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener:
 - 1) Screw.
 - 2) Self.
 - c. Location as directed by Owner.
 - d. Legend:
 - 1) Letter height: 4 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "Clarifier CL-xxx").
8. Tanks (less than 1000 GAL) (e.g., break tanks, chemical tanks, hydro-pneumatic tanks, air receivers, etc.):
- a. Tag type:
 - 1) Type D - Self-Adhesive Tape Tags and Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 2 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "Polymer Storage Tank Txxx")

9. Equipment that starts automatically:
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener:
 - 1) Type B2 - Screw or adhesive.
 - 2) Type D - Self.
 - c. Size: 5 IN x 7 IN
 - d. Location: XXEquipment nameXX.
 - e. Legend:
 - 1) OSHA Warning Sign.
 - 2) Description of Warning: "THIS MACHINE STARTS AUTOMATICALLY".

B. Instrumentation Systems:

1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
 - a. Tag type:
 - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
 - 2) Indoor noncorrosive:
 - a) Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - 3) Indoor corrosive:
 - a) Stainless steel Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - b. Fastener:
 - 1) Type A1: Chain of the same material.
 - 2) Type B1: Stainless steel chain.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Equipment ISA designation as indicated on the Drawings (e.g., "FIT-xxx").

2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/2 IN minimum.
 - 2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").
3. Components inside equipment enclosure, (e.g., PLC's, control relays, contactors, and timers):
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 IN minimum.
 - 2) Description or function of component (e.g., "PLC-xxx" or "CR-xxx").
4. Through enclosure door mounted components (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Component ISA tag number as indicated on the Drawings (e.g., "HS-xxx").

C. HVAC Systems:

1. General:
 - a. Provide arrows and markers on ducts.
 - 1) At 20 FT maximum centers along continuous lines.
 - 2) At changes in direction (route) or obstructions.
 - 3) At dampers, risers, branches, machinery or equipment.
 - 4) Where ducts pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
 - b. Position markers on both sides of duct with arrow markers pointing in flow direction.

- 1) If flow is in both directions use double headed arrow markers.
- c. Apply tapes and stenciling in uniform manner parallel to ducts.
2. HVAC Equipment (e.g., unit heaters, exhaust fans, air handlers, etc.):
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "EF-xxx").
3. Ductwork:
 - a. Tag type:
 - 1) Type D - Self-Adhesive Tape Tags and Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 1 IN minimum.
 - 2) Description of ductwork, (e.g., "AIR SUPPLY").
 - 3) Arrows: Single arrow.
4. Enclosure for instrumentation and control equipment, (e.g., fan control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/2 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "FAN CONTROL PANEL FCP-xxx").
5. Wall mounted thermostats:
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener: Self.

- c. Legend:
 - 1) Letter height: 3/16 IN minimum.
 - 2) Description of equipment controlled (e.g., "UH-xxx" or AHU-xxx").
- 6. Components inside equipment enclosure, (e.g., controller's, control relays, contactors, and timers):
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 IN minimum.
 - 2) Description or function of component (e.g., "CR-xxx").
- 7. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
- D. Electrical Systems:
 - 1. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
 - a. Tag type: Type F - Underground Warning Tape.
 - b. Letter height: 1-1/4 IN minimum.
 - c. Location:
 - 1) Where trench is 12 IN or more below finished grade: In trench 6 IN below finished grade.
 - 2) Where trench is less than 12 IN below finished grade: In trench 3 IN below finished grade.
 - d. Electrical power (e.g., low and medium voltage):
 - 1) Color: Red with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION".

- b) Second line: "BURIED ELECTRIC LINE BELOW".
- e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
 - 1) Color: Orange with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION".
 - b) Second line: "BURIED COMMUNICATION LINE BELOW".
- 2. Switchgear, switchboards and motor control centers:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Main equipment legend:
 - 1) Letter height:
 - a) First line: 1 IN minimum.
 - b) Subsequent lines: 3/8 IN minimum.
 - 2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSBxxx").
 - 3) Second line:
 - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
 - b) Include the building name or number if the source is in another building.
 - 4) Third line: System voltage and phase (e.g., "480/277 V, 3PH").
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
 - d. Main and feeder device legend:
 - 1) Letter height: 3/8 IN minimum.
 - 2) Description of load (e.g., "MAIN DISCONNECT", "PUMP Pxxx" or "PANELBOARD HPxxx").
- 3. Panelboards and transformers:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height:

- a) First line: 3/8 IN minimum.
 - b) Subsequent lines: 3/16 IN minimum.
 - 2) First line: Equipment name (e.g., "PANELBOARD LPxxx" or "TRANSFORMER Txxx").
 - 3) Second line (panelboards only): System voltage and phase (e.g., "208/120V, 3PH").
 - 4) Third line:
 - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
 - b) Include the building name or number if the source is in another building.
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
4. Transfer switches:
- a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height:
 - a) First line: 3/8 IN minimum.
 - b) Subsequent lines: 3/16 IN minimum.
 - 2) First line: Equipment name (e.g., "AUTOMATIC TRANSFER SWITCH ATsxxx").
 - 3) Second line: Normal source of power (e.g., "NORMAL SOURCE FED FROM MCCxxx").
 - 4) Third line: Emergency source of power (e.g., "EMERGENCY SOURCE FED FROM SGENxxx").
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
5. Safety switches, separately mounted circuit breakers and motor starters, VFD's, etc.:
- a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.

- 2) First line: Description of load equipment is connected to (e.g., "PUMP Pxxx").
6. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/2 IN minimum.
 - 2) Equipment name (e.g., "LIGHTING CONTROL PANEL LCPxxx").
7. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 IN minimum.
 - 2) Description or function of component (e.g., "M-xxx", "CR-xxx" or "TR-xxx").
8. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
9. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Tag conductor at both ends.
 - d. Legend:
 - 1) Letter height: 1/8 IN minimum.

- 2) Circuit number or wire number as scheduled on the Drawings or as furnished with the equipment.
10. Conductors in handholes and manholes.
 - a. Tag type: Type A3 - Metal Tape Tags.
 - b. Fastener: Nylon strap.
 - c. Tag conductor at both ends.
 - d. Legend:
 - 1) Letter height: 1/8 IN minimum.
 - 2) Circuit number or wire number as scheduled on the Drawings.
 11. Grounding conductors associated with grounding electrode system in accordance with the following:
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 1/8 IN minimum.
 - 2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").
 12. Flash protection for switchboards, panelboards, industrial control panels and motor control centers:
 - a. Tag type: Type D - Self-Adhesive Tape Signs.
 - b. Fastener: Self.
 - c. Legend: Per NFPA 70.
 13. Entrances to electrical rooms:
 - a. Tag type: Type B2 - Nonmetallic Signs.
 - b. Fastener: Screw or adhesive.
 - c. Size: 5 IN x 7 IN.
 - d. Location: Each door to room.
 - e. Legend:
 - 1) OSHA Danger Sign.
 - 2) Description of Danger: "HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY".

14. Equipment where more than one (1) voltage source is present:

- a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
- b. Fastener:
 - 1) Screw or adhesive.
 - 2) Self.
- c. Size: 1-3/4 IN x 2-1/2 IN.
- d. Location: Exterior face of enclosure or cubical.
- e. Legend:
 - 1) OSHA Danger Sign.
 - 2) Description of Danger: "MULTIPLE VOLTAGE SOURCES".

3.03 HAZARD AND SAFETY SIGNS

- A. Provide 25 Hazard and Safety Signs:
 - 1. Type B2.
 - 2. Inscription as directed by Owner.

END OF SECTION

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SECTION 10444

SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Room identification signs.
2. Other identification signs:
 - a. Fire and/or smoke barrier identification signs.
3. Aluminum letters.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 10400 - Identification Devices.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. Americans with Disabilities Act (ADA):
 - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
2. ASTM International (ASTM):
 - a. B26, Standard Specification for Aluminum-Alloy Sand Castings.
3. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, As well as Florida Building Code, 2015 Edition including all amendments, referred to herein as Building Code.

1.03 DEFINITIONS

- A. Wet and/or Corrosive Areas: For the purposes of this Specification Section, the following rooms or areas are considered wet and/or corrosive:

1.04 SUBMITTALS

- A. Shop Drawings:

1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Color charts for Engineer's color selection.
 - 1) Color selection shall be made from manufacturer's complete color line including all premium and special colors.
3. Schedule of all signs indicating text and graphics.
4. Layout drawings of all signage showing size, letter style, text, border, finish, and installation detail.
 - a. Provide drawings for:
 - 1) Room, and stair identification signs.
 - 2) Fire and/or smoke barrier identification signs.
 - 3) Aluminum letters.

B. Samples:

1. Room stair identification signs.
2. Fire and/or smoke barrier identification signs.
3. Aluminum letters.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Room stair identification signs:
 - a. ASE - Architectural Signs and Engraving.
 - b. ASI Signage Innovations.
 - c. Best Sign Systems.
 - d. Mohawk Sign Systems.
 - e. Nelson-Harkins.

- f. Southwell Co.
- g. Stamprite Supersine Identification Specialists.
- 2. Fire and/or smoke barrier identification signs:
 - a. Brady.
 - b. Panduit.
 - c. Seton.
 - d. Carlton Industries.
- 3. Aluminum letters:
 - a. A R K Ramos Manufacturing Co., Inc.
 - b. ASI Signage Innovations.
 - c. Leeds Architectural Letters.
 - d. Metal Arts.
 - e. Metallic Arts.
 - f. The Southwell Co.

B. Submit request for substitution in accordance with Specification Section 01640.

2.02 MATERIALS

A. Room and Stair Identification Signs:

- 1. Interior:
 - a. Dry, non-corrosive areas: Melamine plastic suitable for raised lettering and Braille.
 - b. Wet and/or corrosive areas: Aluminum or fiberglass suitable for raised lettering and Braille.
- 2. Exterior: Aluminum or fiberglass suitable for raised lettering and Braille.

B. Fire and/or Smoke Barrier Identification Signs:

- 1. Self-adhesive vinyl tape or vinyl cloth Stenciling system.

C. Aluminum Letters:

- 1. Cast aluminum ASTM B26.
- 2. For machine cut letters, provide aluminum of appropriate alloy and hardness.

2.03 FABRICATION

A. Room Identification Signs:

1. General:

- a. Raised text, border and graphics.
 - 1) Minimum 1/32 IN height.
 - 2) Provide international graphic symbology for all toilet, locker and shower rooms or combinations thereof, and for unisex toilet rooms and stairs.
 - 3) Provide handicap symbol on all signs for rooms meeting handicap requirements.
- b. Grade 2 Braille.
- c. Finish: Eggshell.
 - 1) Color: To be selected.
- d. Text:
 - 1) Typeface: Sans Serif.
 - 2) Size: Minimum 3/4 IN high.
- e. Text as indicated in the SCHEDULES Article in PART 3 of this Specification Section.
- f. Exterior signs shall be rated for exterior use.
- g. All signs shall comply with requirements of ADA state or local authority, as appropriate.

B. Fire and/or Smoke Barrier Identification Signs:

1. Self-adhesive tape tags and signs:

- a. Materials: Vinyl tape or vinyl cloth.
- b. Size:
 - 1) Surface: As required by text.
 - 2) Thickness: 5 mils minimum.
- c. Fabrication:
 - 1) Indoor/Outdoor grade.
 - 2) Weather and UV resistant inks.
 - 3) Permanent adhesive.

- 4) Legend: Preprinted.
 - 5) Self-laminating.
 - d. Color: White with black lettering or as specified.
2. Stenciling system:
- a. Materials:
 - 1) Exterior type stenciling enamel.
 - 2) Either brushing grade or pressurized spray can form and grade.
 - b. Size: As required.
 - c. Fabrication:
 - 1) Legend: As required.
 - d. Color: Black or white for best contrast.
- C. Hazard Communication Signage (OSHA signage): See Specification Section 10400.
- D. Aluminum Letters:
1. General:
 - a. Cast aluminum, machine cut or laser cut aluminum.
 - b. Finish: Anodized.
 - c. Color: Clear.
 - d. Mounting:
 - 1) 1 IN projected.
 - 2) Provide stainless steel mounting studs.
 - e. Text as indicated in the SCHEDULES Article in PART 3 of this Specification Section.
 2. Letters:
 - a. Style: Helvetica.
 - b. Size: Upper case, 2 IN high.
 - c. Depth: 3/8 IN.
 3. Provide true angles, crisp corners and straight edges with no burrs or pitting in the surface.
- E. Site Signs:

2.04 MAINTENANCE MATERIALS

- A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Room Identification Signs:

1. Install signs using foam tape for interior signs and stainless steel screws (minimum of two (2)) for exterior signs.
 - a. Stainless steel screws shall be painted to match sign color.
2. Mounting Locations:
 - a. Tactile characters on signs shall be located 48 IN minimum above the finished floor or ground surface, measured from the baseline of the lowest tactile character and 60 IN maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.
 - b. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leaves, the sign shall be located to the right side of the right hand door. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.
 - c. Signs containing tactile characters shall be located so that a clear floor space of 18 IN minimum by 18 IN minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
3. Interior and exterior signs identifying permanent rooms and spaces shall comply with ADA state or local authority, as appropriate.

B. Fire and/or Smoke Barrier Identification Signs:

1. Provide marking and identification in compliance with Building Code.
2. Locate in accessible concealed floor, floor-ceiling, or attic spaces.
3. Repeat at intervals not exceeding 15 FT measured horizontally.
4. Lettering: Not less than 1/2 IN high.

C. Aluminum Letters:

1. Install letters where indicated on Drawings.
2. Mount to walls with 1 IN projection in accordance with manufacturer's instructions.

3.02 SCHEDULES

A. Room Identification Signs:

BUILDING LOCATION	MOUNTING	VERBIAGE	REMARKS
OPERATIONS BUILDING			
DOOR 11-102A	EXTERIOR	OFFICE	2
DOOR 11-102B	INTERIOR	OFFICE	3
DOOR 11-103A	EXTERIOR	MAINTENANCE	2
DOOR 11-103D	INTERIOR	MAINTENANCE	3
DOOR 11-104A	INTERIOR	LUNCH ROOM	3
DOOR 11-105A	INTERIOR	WOMEN	1, 3
DOOR 11-106A	INTERIOR	MEN'S LOCKER ROOM	1, 3
DOOR 11-107A	EXTERIOR	OPERATIONS	2
DOOR 11-108A	INTERIOR	INVENTORY	3
DOOR 11-108A	INTERIOR	INVENTORY	2
SLUDGE HANDLING BUILDING			
DOOR 11-109A	EXTERIOR	TRUCK LOADING	2
DOOR 11-109C	EXTERIOR	TRUCK LOADING	2
DOOR 11-109E	EXTERIOR	TRUCK LOADING	2
DOOR 11-110A	EXTERIOR	AUXILLIARY STORAGE	2
DOOR 11-111A	INTERIOR	POLYMER STORAGE	2
DOOR 11-112A	INTERIOR	STAIR	1, 3
DOOR 11-112A	INTERIOR	PUMP ROOM AUTHORIZED PERSONNEL ONLY	2
DOOR 11-112B	INTERIOR	PUMP ROOM AUTHORIZED PERSONNEL ONLY	2
DOOR 11-112B	INTERIOR	TRUCK LOADING	3
DOOR 11-112C	EXTERIOR	PUMP ROOM AUTHORIZED PERSONNEL ONLY	2
DOOR 11-113A	EXTERIOR	STAIR	2
DOOR 11-202A	INTERIOR	SLUDGE DEWATERING	2
DOOR 11-203A	INTERIOR	UNISEX RESTROOM	1, 3
DOOR 11-204A	INTERIOR	OPERATOR ROOM	2
DOOR 11-204A	INTERIOR	STAIR	1, 3
DOOR 11-204B	INTERIOR	SLUDGE THICKENING	2
DOOR 11-204B	INTERIOR	OPERATOR ROOM	3

PROJECT NO. 11843 PROGRESSO VILLAGE STORM WATER IMPROVEMENTS

BUILDING LOCATION	MOUNTING	VERBIAGE	REMARKS
DOOR 11-205A	INTERIOR	ELECTRICAL ROOM AUTHORIZED PERSONNEL ONLY	2
DOOR 11-205B	INTERIOR	ELECTRICAL ROOM AUTHORIZED PERSONNEL ONLY	3
DOOR 11-206A	EXTERIOR	SLUDGE THICKENING	2
DOOR 11-207A	INTERIOR	UTILITY ROOM	2
DOOR 11-208B	INTERIOR	STAIR	1, 3
DOOR 11-208B	INTERIOR	SLUDGE DEWATERING	2
DOOR 11-208C	INTERIOR	ROOF ACCESS AUTHORIZED PERSONNEL ONLY	3
REMARKS: 1. Provide Universal Graphic Symbology. 2. Mount adjacent to pull side of door. 3. Mount adjacent to push side of door.			

B. Fire and/or Smoke Barrier Identification Signs:

1. FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS

END OF SECTION

SECTION 10520
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Portable fire extinguishers.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 05500 - Metal Fabrications.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. Americans with Disabilities Act (ADA):
 - a. 2010 ADA Standards for Accessible Design.
2. National Fire Protection Association (NFPA):
 - a. 10, Standard for Portable Fire Extinguishers.
3. Underwriters Laboratories, Inc. (UL):
 - a. 8, Water Based Agent Fire Extinguishers.
 - b. 154, Carbon Dioxide Fire Extinguishers.
 - c. 299, Dry Chemical Fire Extinguishers.
 - d. 626, Water Fire Extinguishers.
 - e. 711, Rating and Fire Testing of Fire Extinguishers.
 - f. 2129, Halocarbon Clean Agent Fire Extinguishers.

1.03 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.

1.04 SUBMITTALS

- A. Shop Drawings:

1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Ratings and classification of extinguishers.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01300 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and install filled and charged extinguishers just prior to building occupancy.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Fire extinguishers:
 - a. Amerex Corporation.
 - b. Ansul – Tyco Fire Protection Products.
 - c. Badger Fire Protection.
 - d. United Technologies - Kidde.
 - e. Buckeye Fire Equipment.
 2. Fire extinguisher signs:
 - a. Seton.
 - b. Compliance Signs.
 - c. Safety Sign.
- B. Submit request for substitution in accordance with Specification Section 01640.

2.02 MANUFACTURED UNITS

A. Fire Extinguisher (FEXT):

1. Steel bodied, all metal top (head) and valves.
2. Multi-purpose dry chemical extinguisher with hose and nozzle.
3. Provide one (1) listed 10 LB. 4A-60BC extinguisher for each fire extinguisher location (FEXT) indicated on Drawings.
4. Finish: Red with epoxy finish coat.

B. Wall Brackets:

1. Bracket type to fit specified extinguisher.
2. Furnish bracket for each extinguisher not in cabinet.
3. Bracket to be finished in red or black enamel.

C. Fire Extinguisher Signage:

1. Single faced: SETON #21999.
2. Double faced: SETON #22001.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and NFPA 10.

1. Install units with extinguisher top not over 48 IN above floor.
2. Install wall brackets to concrete or masonry substrate with self-tapping concrete anchors.
 - a. See Specification Section 05500.

B. Fire extinguisher locations shown on Drawings are approximate locations.

1. Verify all extinguisher mounting locations with the AHJ.

C. Provide "FIRE EXTINGUISHER" sign for each extinguisher location.

1. Provide single or double faced sign to provide optimum visibility for extinguisher location.

END OF SECTION

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SECTION 11005

EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.

B. Related Sections include but are not necessarily limited to:

1. Division 01 - General Requirements.
2. Section 15062 – Ductile Iron Pipe.
3. Section 3300 - Cast-in-Place Concrete.
4. Section 05010 - Metal Materials.
5. Section 07920 - Sealants and Caulking.
6. Section 09900 - Painting.
7. Section 10400 - Identification Devices.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Bearing Manufacturers Association (ABMA).
2. American Gear Manufacturers Association (AGMA).
3. ASTM International (ASTM):
 - a. E1934, Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.
 - b. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
4. Hydraulic Institute (HI):
 - a. 9.6.4, Centrifugal and Vertical Pumps for Vibration Measurements and Allowable Valves.
5. International Electrotechnical Commission (IEC).
6. Institute of Electrical and Electronics Engineers, Inc. (IEEE).

7. International Organization for Standardization (ISO):
 - a. 1940, Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances.
 - b. 21940-11, Mechanical Vibration - Rotor Balancing - Part 11: Procedures and Tolerances for Rotors with Rigid Behavior.
 8. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 6, Enclosures for Industrial Control and System.
 - c. MG 1, Motors and Generators.
 9. InterNational Electrical Testing Association (NETA):
 - a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
 10. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):
 11. National Institute for Certification in Engineering Technologies (NICET).
 12. National Institute of Standards and Technology (NIST).
 13. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
 14. Underwriters Laboratories, Inc. (UL).
 - a. 508, Standard for Safety Industrial Control Equipment.
 - b. 508A, Standard for Safety Industrial Control Panels.
 - c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
 15. Vibration Institute.
- B. Natural frequency analysis firm:
1. An independent firm, whose sole or principal part of its business is the calculation of and analysis of natural frequencies of rotating equipment.
 2. Minimum of 10 years experience.
 3. Employs a registered professional engineer who has experience in finite element analysis, rotordynamic analysis and experimental modal analysis.

- a. Minimum five (5) years combined field testing and data analysis experience.
- b. Qualified Vibration Category III certification from the Vibration Institute.

C. Vibration Testing Program:

1. Testing firm:

- a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
- b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.

2. Field personnel:

- a. Minimum of three (3) years field experience covering all phases of field vibration testing and data gathering.
- b. Qualified Vibration Category II certification from the Vibration Institute.

3. Analysis personnel:

- a. Minimum five (5) years combined field testing and data analysis experience.
- b. Qualified Vibration Category III certification from the Vibration Institute.

D. Infrared Thermography Testing Program:

1. Testing firm:

- a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
- b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.

2. Field personnel:

- a. Minimum of one (1) year field experience covering all phases of field thermography testing and data gathering.
- b. Supervisor certified by NETA or NICET.

3. Analysis personnel:

- a. Minimum three (3) years combined field testing and data analysis experience.
- b. Supervisor certified by NETA or NICET.

E. Electrical Equipment and Connections Testing Program:

1. Testing firm:

- a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration , and adjusting of systems.
 - b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.
2. Field personnel:
- a. Minimum of one (1) year field experience covering all phases of electrical equipment inspection, testing, and calibration.
 - b. Relay test technician having previous experience with testing and calibration of relays of the same manufacturer and type used on project and proficient in setting and testing the types of protection elements used.
 - c. Supervisor certified by NETA or NICET.
3. Analysis personnel:
- a. Minimum three (3) years combined field testing and data analysis experience.
 - b. Supervisor certified by NETA or NICET.
- F. Miscellaneous:
1. A single manufacturer of a "product" shall be selected and utilized uniformly throughout Project even if:
 - a. More than one (1) manufacturer is listed for a given "product" in Specifications.
 - b. No manufacturer is listed.
 2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 designations shown on Electrical Power Drawings and defined in the Electrical specifications.

1.03 DEFINITIONS

- A. Product: Manufactured materials and equipment.
- B. Major Equipment Supports - Supports for Equipment:
1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS or greater, or;
 2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater, or;
 3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.

C. Equipment:

1. One (1) or more assemblies capable of performing a complete function.
2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.
3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.

D. Installer or Applicator:

1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

1.04 SUBMITTALS

A. Shop Drawings:

1. General for all equipment:
 - a. See Section 01300 for requirements for the mechanics and administration of the submittal process.
 - b. Data sheets that include manufacturer's name and complete product model number.
 - 1) Clearly identify all optional accessories that are included.
 - c. Acknowledgement that products submitted comply with the requirements of the standards referenced.
 - d. Manufacturer's delivery, storage, handling, and installation instructions.
 - e. Equipment identification utilizing numbering system and name utilized in Drawings.
 - f. Equipment installation details:
 - 1) Location of anchorage.
 - 2) Type, size, and materials of construction of anchorage.
 - 3) Anchorage setting templates.
 - 4) Manufacturer's installation instructions.
 - g. Equipment area classification rating.
 - h. Shipping and operating weight.
 - i. Equipment physical characteristics:
 - 1) Dimensions (both horizontal and vertical).

- 2) Materials of construction and construction details.
 - j. Equipment factory primer and paint data.
 - k. Manufacturer's recommended spare parts list.
 - l. Equipment lining and coatings.
 - m. Equipment utility requirements include air, natural gas, electricity, and water.
 - n. Ladders and platforms provided with equipment:
 - 1) Certification that all components comply fully with OSHA requirements.
 - 2) Full details of construction/fabrication.
 - 3) Scaled plan and sections showing relationship to equipment.
2. Mechanical and process equipment:
- a. Operating characteristics:
 - 1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
 - 2) Brake horsepower requirements.
 - 3) Copies of equipment data plates.
 - b. Piping and duct connection size, type and location.
 - c. Equipment bearing life certification.
 - d. Equipment foundation data:
 - 1) Equipment center of gravity.
 - 2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
3. Electric motor:
- a. Motor manufacturer and model number.
 - b. Complete motor nameplate data.
 - c. Weight.
 - d. NEMA design type.
 - e. Enclosure type.
 - f. Frame size.
 - g. Winding insulation class and temperature rise.

- h. Starts per hour.
- i. Performance data:
 - 1) Motor speed-torque curve superimposed over driven machine speed-torque curve during start-up acceleration and at rated terminal voltage a minimum permissible or specified terminal voltage for all motors over 500 HP.
 - 2) Time-current plots with acceleration versus current and thermal damage curves at the operating and ambient temperatures and at rated terminal voltage and minimum permissible or specified terminal voltage for all motors over 500 HP.
 - 3) Guaranteed minimum efficiencies at 100 PCT, 75 PCT, and 50 PCT of full load
 - 4) Guaranteed minimum power factor at 100 PCT, 75 PCT, and 50 PCT of full load.
 - 5) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.
 - 6) Starting, full load, and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.
- j. Bearing data and lubrication system.
- k. Natural frequency calculations for:
 - 1) Completed assembly including but not limited to the equipment base, rotating piece of equipment, and the rotating piece of equipment driver.
 - 2) Individual piece of rotating equipment.
 - 3) Equipment driver and connected gear reducer, if applicable.
- l. Thermal protection system including recommended alarm and trip settings for winding and bearing RTD's.
- m. Fabrication and/or layout drawings:
 - 1) Dimensioned outlined drawing.
 - 2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).
- n. Certifications:
 - 1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
 - 2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.

- a) Include minimum speed at which the motor may be operated for the driven machinery.
- o. Electrical gear:
 - 1) Unless specified in a narrow-scope Specification Section, provide the following:
 - a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.
 - 2) Control panels:
 - a) Panel construction.
 - b) Point-to-point ladder diagrams.
 - c) Scaled panel face and subpanel layout.
 - d) Technical product data on panel components.
 - e) Panel and subpanel dimensions and weights.
 - f) Panel access openings.
 - g) Nameplate schedule.
 - h) Panel anchorage.
 - i) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.
- 4. Systems schematics and data:
 - a. Provide system schematics where required in system specifications.
 - 1) Acknowledge all system components being supplied as part of the system.
 - 2) Utilize equipment, instrument and valving tag numbers defined in the Contract Documents for all components.
 - 3) Provide technical data for each system component showing compliance with the Contract Document requirements.
 - 4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.
- 5. For factory painted equipment, provide paint submittals in accordance with Section 09900.
- 6. Qualifications for:
 - a. Natural frequency analysis firm and personnel.
 - b. Vibration testing firm and personnel.

- c. Infrared thermography testing firm and personnel.
 - d. Electrical equipment and connections testing firm and personnel.
7. Equipment Monitoring and Testing plans, in accordance with PART 3 of this Specification Section:
- a. Natural frequency analysis and calculations.
 - b. Vibration testing.
 - c. Thermography testing.
 - d. Electrical equipment and connection testing.

B. Factory Test Reports

- 1. Natural frequency bump test reports where required for rotating equipment.
 - a. Minimum characteristics of impact hammer.
 - 1) Frequency Range 1 kHz
 - 2) Range (5v output) 5,000 LBf (22,200 N)
 - 3) Hammer Sensitivity (9pprox.) 1 mV/lbf (0.23 mV/N)
 - 4) Resonant Frequency 12 kHz
- 2. Motor, equipment and final assembled equipment including motor.
 - a. Determine natural frequency of assembled motor prior to shipping to OEM or job site.
 - 1) Individual motor fastened to an "infinitely rigid" mass at the same bolt circle as the final assembled equipment.
 - b. Determine natural frequency of the pump.
 - 1) Pump fastened to an "infinitely rigid" mass at the same bolt circle as the final assembled equipment.
 - c. Determine natural frequency of the pump/motor assembly.
 - 1) Pump/motor assembly fastened to an "infinitely rigid" mass at the same bolt circle as the final field assembled equipment.
 - d. For this use, the "infinitely rigid" mass shall be at least 10 times the weight of the equipment being tested.
- 3. Submit natural frequency report(s) for approval prior to shipment.
- 4. Equipment performance tests.
 - a. As listed in individual equipment specifications.

C. Contract Closeout Information:

1. Operation and Maintenance Data:

- a. See Section 01430 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

D. Informational Submittals:

1. Sample form letter for equipment field certification.
2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
3. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
4. Field noise testing reports if such testing is specified in narrow-scope Specification Sections.
5. Notification, at least one (1) week in advance, that motor testing will be conducted at factory.
6. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
7. Motor test reports.
8. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.
9. Provide three (3) bound final written reports documenting natural frequency testing, vibration monitoring and testing for specified equipment.
 - a. Include the acceptance criteria of all equipment tested.
 - b. Provide individual tabbed sections for information associated with each piece of tested equipment.
10. Preliminary field quality control testing format to be used as a basis for final field quality control reporting.
11. Testing and monitoring reports in accordance with PART 3 of this Specification Section.
12. Certification that driven equipment and VFD are compatible.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Motors:
 - a. Baldor.
 - b. General Electric.
 - c. Hyundai Heavy Industries.
 - d. Marathon Electric.
 - e. Rockwell - Reliance.
 - f. Siemens.
 - g. TECO-Westinghouse.
 - h. Toshiba U.S.
 - i. U.S. Motors, Nidec Motor Corporation.
 - j. WEG.
 - k.

B. Submit request for substitution in accordance with Section 01640.

2.02 MANUFACTURED UNITS

A. Electric Motors:

1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
2. Design for frequent starting duty equivalent to duty service required by driven equipment.
3. Design for full voltage starting.
4. Design bearing life based upon actual operating load conditions imposed by driven equipment.
5. Size for altitude of Project.
6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
7. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.

8. AC electric motors less than 1/3 HP:
 - a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.
 - c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
9. AC electric motors 1/3 to 1 HP:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.
 - 1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
10. AC electric motors 1-1/2 to 10 HP:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.
 - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
11. AC electric motors greater than 10 HP:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
 - 1) Design bearing life for 90 PCT survival rating at 50,000 HRS of operation for motors up to and including 100 HP.
 - 2) For motors greater than 100 HP, design bearing life for 90 PCT survival rating at 100,000 HRS of operation.
 - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
 - d. Thermal protection:
 - 1) For motors 50 HP and above controlled from a variable frequency drive and for all other motors 100 HP and above, provide integral thermal detectors with normally closed contacts that will open on overtemperature or resistance type temperature detector (RTD) complete with monitor and alarm panel having a normally closed contact that will open on overtemperature.
 - a) Two (2) thermal sensing devices per phase in each phase hot-spot location.
 - b) Monitor and alarm panel:

- (1) For constant speed motors, install panel in and energize from the motor starter equipment.
 - (2) For variable speed motors, install panel in and energize from the variable speed drive equipment.
12. Severe duty motor to have the following minimum features:
- a. All cast iron construction.
 - b. Gasketed conduit box.
 - c. Epoxy finish for corrosion protection.
 - d. Hydrosopic varnish on windings for corrosion protection.
 - e. Drain plug and breather.
- B. NEMA Design Squirrel Cage Induction Motors:
1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
 2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
 3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
 4. For use on variable frequency type adjustable speed drives, provide:
 - a. Induction motors that are in compliance with NEMA MG 1, Part 31.
 - b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.
 - c. Insulated drive end bearing on all motors.
 - d. Insulated non-drive end bearings, at a minimum, on all motors with horizontal shaft 100 HP and larger.
 - e. An insulated bearing carrier on the non-drive end for vertical shaft motors 100 HP and larger.
 - f. Shaft grounding ring on all motors:
 - 1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
 - 2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
 - g. Have the following minimum turndown ratio without the use of additional cooling, such as a blower, to provide continuous supply of cooling air over the motor.
 - 1) Variable torque: 10:1.

- 2) Constant torque: 6:1.
- 5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 DEGC ambient.
- 6. Design motors for continuous duty.
- 7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 PCT greater than the maximum HP requirements of the driven equipment over its entire operating range.
 - a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
- 8. Motor enclosure and winding insulation application:
 - a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Wet outdoor Areas	
Corrosive Areas	TEFC, Severe/ Chemical Duty
Class I, Division 1 Areas	Explosion Proof, Approved for Class I Division 1 Locations
Class II, Division 1 Areas	Explosion Proof, Approved for Class II Division 1 Locations
Class I or Class II, Division 2 Areas	Explosion Proof, Approved for Division 1 Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area, Encapsulated Windings

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

- 9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
- 10. Balance motors to ISO G2.5 level.
 - a. Submit prior to shipping to OEM or job site.
- C. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.
- D. V-Belt Drive:
 - 1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
 - 2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
 - 3. Provide staticproof belts.
- E. Vibration Isolators:
 - 1. Provide all equipment subject to vibration with restrained spring type vibration isolators or pads according to the manufacturer's written recommendation.
- F. Space Heaters:

1. Silicone rubber strip type, 120 V rated.
2. Provided on:
 - a. All motors 10 HP and larger mounted outdoors.
 - b. Indoor motors in humid environments as indicated.

2.03 COMPONENTS

A. Gear Drives and Drive Components:

1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.
2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.
3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is precluded.
4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible couplings meeting applicable standards of AGMA.
5. Gear reducers:
 - a. Provide gear reducer totally enclosed and oil lubricated.
 - b. Utilize antifriction bearings throughout.
 - c. Provide worm gear reducers having a service factor of at least 1.20.
 - d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

2.04 ACCESSORIES

A. Guards:

1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
2. Interior applications:
 - a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
 - b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
 - c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
3. Exterior applications:
 - a. Construct from 16 GA stainless steel or aluminum.
 - b. Construct to preclude entrance of rain, snow, or moisture.

- c. Roll to conform to shaft or coupling surface.
- d. Connect to equipment frame with stainless steel bolts and wing nuts.

B. Anchorage:

- 1. Cast-in-place anchorage:
 - a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
 - b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
 - c. Provide two (2) nuts for each bolt.
- 2. Drilled anchorage:
 - a. Adhesive anchors per Section 03151.
 - b. Epoxy grout per Section 03315.
 - c. Threaded rods same as cast-in-place.

C. Data Plate:

- 1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
- 2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.

D. Gages:

- 1. Provide at the following locations:
 - a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical and process equipment.
 - b. At locations identified on Drawings.
- 2. Utilize tapping sleeves for mounting.

E. Lifting Eye Bolts or Lugs:

- 1. Provide on all equipment 50 LBS or greater.
- 2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.

F. Platforms and Ladders:

- 1. Design and fabricate in accordance with OSHA Standards.
- 2. Fabricate components from aluminum.

3. Provide platform surface: Non-skid grating, unless specified in narrow-scope Specification Sections.

2.05 FABRICATION

- A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.
- B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.
- C. Furnish like parts of duplicate units to be interchangeable.
- D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.
- E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
 1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.
- F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
 1. Provide drain connection for 3/4 IN PVC tubing.
- G. Machine the mounting feet of rotating equipment.
- H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that can not be properly prepared and painted.
 1. When such back to back fabrication can not be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
 2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Section 07920.
- I. Natural frequency/critical Speed:
 1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
 2. Excessive vibration is sufficient cause for equipment rejection.
 3. Ratio of all rotative speeds to natural frequency/critical speed of a unit or components: Greater than 1.2.
- J. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
 1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.

2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.
 - a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
 - a. Determine the SCCR rating by one of the following methods:
 - 1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - 2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
 - 3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
 - b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
 - c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

2.06 SHOP OR FACTORY PAINT FINISHES

A. Electrical Equipment:

1. Provide factory-applied paint coating system(s) for all electrical equipment components except those specified in Section 09900 to receive field painting.
 - a. Field painted equipment: See Section 09900 for factory applied primer/field paint compatibility requirements.

B. Field paint other equipment in accordance with Section 09900.

1. See Section 09900 for factory applied primer/field paint compatibility requirements.

2.07 SOURCE QUALITY CONTROL

A. Motor Tests:

1. Test motors in accordance with NEMA and IEEE standards.
2. Provide routine test for all motors.
3. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.

- a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
- b. Pay all costs, including shipping and handling, for all motors failing the tests.
- c. If two (2) successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.

B. Balance:

1. Unless specified otherwise, for all equipment 10 HP or greater, all rotating elements in motors, pumps, blowers, and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. Balance all rotating elements to the following criteria, per ISO 21940-11:

$$U_{per} = \frac{G \times 6.015 \times W/2}{N}$$

Where:

U_{per} = Permissible residual unbalance for each correction plane in ounce-inches (OZ-IN). See ISO 21940-11 for acceptable values.

G = ISO Balance Quality Grade Number, per ISO 21940-11

W = Rotor weight in pounds

N = Maximum continuous operating RPM

- a. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.
- B. Utilize templates for anchorage placement for slab-mounted equipment.
- C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
 1. Route clear of major traffic areas and as approved by Engineer.
- D. DO NOT construct foundations until major equipment supports are approved.
- E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.
- F. Equipment Base:

1. Construct level in both directions.
2. Take particular care at anchor bolt locations so these areas are flat and level.

G. Machine Base:

1. Mount machine base of rotating equipment on equipment base.
 - a. Level in both directions, using a machinist level, according to machined surfaces on base.
2. Level machine base on equipment base and align couplings between driver and driven unit using stainless steel blocks and shims.
 - a. Blocks and shims milled flat and coplanar of both faces.
 - b. Maximum of 3 shims under each foot.
 - c. Size blocks and shims to provide solid support at each mounting bolt location.
 - 1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
 - d. Provide blocks and shims at each mounting bolt.
 - 1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
 - e. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.

H. Rotating equipment Couplings:

1. Align in the annular and parallel positions.
 - a. For equipment rotating at 1200 RPM or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller.
 - b. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
 - c. For equipment rotating at speeds greater than 1200 RPM allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
3. Check surfaces for runout before attempting to trim or align units.

I. Grouting:

1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and mounting bolts tightened to correct torque value, place a dam or

formwork around base to contain grouting between equipment base and equipment support pad.

- a. Extend dam or formwork to cover leveling shims and blocks.
 - b. Do not use nuts below the machine base to level the unit.
2. Saturate top of roughened concrete subbase with water before grouting.
- a. Add grout until entire space under machine base is filled to the top of the base underside.
 - b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.
3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface.
- a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.
 - b. When the grout has fully hardened (after a minimum of seven (7) days) tighten all anchor bolts to engage equipment base to grout, shims, and equipment support pad.
 - c. Recheck driver-driven unit for proper alignment.

3.02 INSTALLATION CHECKS

- A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.
- B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
1. Has been properly installed and lubricated.
 2. Is in accurate alignment.
 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
 4. Has been operated under full load conditions and that it operated satisfactorily.
 - a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.
- C. No separate payment shall be made for installation checks.
1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

3.03 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

- A. Identify equipment and install hazard warning signs in accordance with Section 10400.

3.04 FIELD PAINTING AND PROTECTIVE COATINGS

- A. For required field painting and protective coatings, comply with Section 09900, Painting.

3.05 WIRING CONNECTIONS AND TERMINATION

- A. Clean wires before installing lugs and connectors.
- B. Coat connection with oxidation eliminating compound for aluminum wire.
- C. Terminate motor circuit conductors with copper lugs bolted to motor leads.
- D. Tape stripped ends of conductors and associated connectors with electrical tape.
 - 1. Wrapping thickness shall be 150 PCT of the conductor insulation thickness.
- E. Connections to carry full ampacity of conductors without temperature rise.
- F. Terminate spare conductors with electrical tape.

3.06 FIELD QUALITY CONTROL

A. General:

- 1. Furnish equipment manufacturer's field quality control services and testing as specified in the individual equipment Specification Sections.
- 2. Execute pre-demonstration requirements in accordance with Section 01660.
- 3. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
- 4. Provide testing of electrical equipment and connections in accordance with the Electrical specifications.
- 5. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
 - a. Contract Drawings and Specifications.
 - b. Related construction change documentation.
 - c. Approved Shop Drawings.
 - d. Approved Operation and Maintenance Manuals.
 - e. Other pertinent information as required.

B. Equipment Monitoring and Testing Plans:

1. Approved in accordance with Shop Drawing submittal schedule.
 2. Included as a minimum:
 - a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
 - b. List and description of testing and analysis equipment to be utilized.
 - c. List of all equipment to be testing, including:
 - 1) Name and tag numbers identified in the Contract Documents.
 - 2) Manufacturer's serial numbers.
 - 3) Other pertinent manufacturer identification,
- C. Instruments Used in Equipment and Connections Quality Control Testing:
1. Minimum calibration frequency:
 - a. Field analog instruments: Not more than 6 months.
 - b. Field digital instruments: Not more than 12 months.
 - c. Laboratory instruments: Not more than 12 months.
 - d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
 2. Carry current calibration status and labels on all testing instruments.
 3. See individual testing programs for additional instrumentation compliance requirements.
- D. Testing and Monitoring Program Documentation:
1. Provide reports with tabbed sections for each piece of equipment tested.
 2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.
 - a. Include legible copies of all forms used to record field test information.
 3. Prior to start of testing, submit one (1) copy of preliminary report format for Engineer review and comment
 - a. Include data gathering and sample test report forms that will be utilized.
 4. In the final report, include as a minimum, the following information for all equipment tested:
 - a. Equipment identification, including:
 - 1) Name and tag numbers identified in the Contract Documents.
 - 2) Manufacturer's serial numbers.

- 3) Other pertinent manufacturer identification,
 - b. Date and time of each test.
 - c. Ambient conditions including temperature, humidity, and precipitation.
 - d. Visual inspection report.
 - e. Description of test and referenced standards, if any, followed while conducting tests.
 - f. Results of initial and all retesting.
 - g. Acceptance criteria.
 - h. "As found" and "as left" conditions.
 - i. Corrective action, if required, taken to meet acceptance.
 - j. Verification of corrective action signed by the Contractor, equipment supplier, and Owner's representative.
 - k. Instrument calibration dates of all instruments used in testing.
 5. Provide three (3) bound final reports prior to Project final completion.
- E. Electrical Equipment and Connections Testing Program:
1. Perform testing on Electrical equipment and connections in accordance with the Electrical specification requirements.
 2. Testing of motors:
 - a. After installation and prior to energizing the motor, perform inspections and tests per NETA ATS 7.15 for all motors 100 HP or above.
 - b. Ensure motor has been lubricated.
 - c. Bump motor to check for correct rotation.
 3. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.
- F. Other Testing:
1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.
 2. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs, and cross members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
 - a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.

G. Infrared Thermography Testing Program:

1. Perform infrared thermography testing for equipment specified in other Divisions during the Equipment Demonstration Period.
 - a. Perform on all rotating and reciprocating equipment having drivers 25 HP or greater.
 - b. Perform on electrical equipment and connections: See Section 16080.
2. Additional requirements for infrared thermography monitoring and testing equipment:
 - a. Temperature range: -10 to 350 DEGC.
 - b. Accuracy: ± 2 PCT or 2 DEGC, whichever is greater.
 - c. Repeatability: ± 1 PCT or 1 DEGC, whichever is greater.
 - d. Temperature indication resolution: 0.1 DEGC.
 - e. Minimum focus distance: 0.3 meters.
 - f. Output in color palettes: JPEG, BMP, or other digital format compatible with Windows.
3. Perform inspection per ASTM E1934.
 - a. Operate VFD driven equipment at 100 PCT speed during thermographic inspection.
4. Acceptability of electrical connections and components based on temperature comparison between components and ambient air temperatures not greater than 10 DEGC per ASTM E1934.
5. Acceptability of motors and equipment bearings based on temperature rise not greater than 5 DegC above the equipment and/or bearing manufacturers published criteria.
6. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.

H. Equipment Vibration Monitoring and Testing Program:

1. Perform vibration monitoring and testing for equipment specified in other Divisions during the Equipment Demonstration Period.
2. Provide vibration testing on all rotating and reciprocating equipment having driver 25 HP and greater or as shown in the Equipment Vibration Testing Schedule.
3. Additional requirements for vibration monitoring and testing equipment at 25 DEGC:
 - a. Requirements for analyzer.

- 1) Frequency range: 10 Hz to 20 kHz
- 2) Frequency Accuracy: 0.02 PCT.
- 3) Non-integrated spectral amplitude accuracy: 5 PCT, 3 Hz to 65kHz.
- 4) Single integrated spectral amplitude accuracy: 5 PCT 10 Hz to 20kHz.
- 5) Supports measurements of acceleration, velocity, displacement, envelope demodulation for bearing defect detection.
- 6) Capable of two-place computer balancing.
- b. Requirements for vibration sensor at 25 DEGC:
 - 1) Sensitivity: ± 5 PCT = 100 mV/g.
 - 2) Acceleration range: ± 50 g.
 - 3) Amplitude nonlinearity: ± 1 PCT.
 - 4) Frequency response: ± 10 Hz to 7 kHz (± 3 dB).
 - 5) Permanently attach vibration test and monitoring mounting pads to mechanical equipment at location recommended by the equipment manufacturer or as recommended by the testing firm.
4. Acceptability of equipment conditions, except pumps, based on ISO 1940-1 Balance Quality Grade G2.5 criteria.
5. Acceptability of pumping equipment to be based on current ANSI/HI criteria:
 - a. ANSI/HI 11.6-2012 for Submersible Pumps in a Wet-pit or Dry-pit configuration.
 - b. ANSI/HI 9.6.4-2009 for all other centrifugal pumps.
6. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.
7. Utilize an Engineer approved testing agency to perform vibration monitoring and testing on equipment defined in the schedule at the end of this Section.
8. Permanently attach vibration test and monitoring mounting pads to the equipment at locations recommended by the equipment manufacturer or as recommended by the vibration testing agency.
9. Utilize mounting pads suitable for permanent installation and for incorporation into a predictable maintenance program.
10. For variable speed equipment provide vibration testing at 1 Hz increments of VFD speed throughout entire operating range.
11. Diagnosis to include, but is not limited to the following:
 - a. Unbalance.

- b. Misalignment.
 - c. Bent shaft.
 - d. Journal bearing related problems.
 - e. Rolling contact bearing problems.
 - f. Mechanical looseness.
 - g. Resonance.
 - h. Foundation flexibility.
 - i. Electrically induced problems.
 - j. Pump problems.
 - k. Fan problems.
 - l. Coupling problems.
 - m. Drive belt problems.
 - n. Gear problems.
 - o. Centrifugal compressor problems.
 - p. Electric motor induced vibration from VFD or VFD carrier frequency.
 - q. Natural frequency of the installed equipment.
12. Provide machinery condition diagnosis based on an acceptable machinery vibration severity guide or machinery fault guide analysis provided by the testing agency, ISO 1940 Balance Quality Grade 6.3 as a minimum.
13. Tolerances for pumping equipment shall be per HI published standards.
14. Repair or replace equipment shown to be out of range of the specified tolerance until the equipment meets the specified normal operation range required in the machinery fault guide analysis.
15. Document testing with written report.
- a. Report to include initial testing results, acceptance criteria, corrective action taken to meet acceptance, verification of corrective action and acceptance report and baseline.
 - b. Natural frequency of installed equipment utilizing an impact hammer.
 - c. Report to include graphical plots of vibration signature for each test point at a scale which illustrates all vibration levels greater than 0.025 ips RMS.

3.07 DEMONSTRATION

- A. Demonstrate equipment in accordance with Section 01660.

END OF SECTION

SECTION 11060

PUMPING EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pumping equipment.
2. Sump pump for valve vault.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 09900 - Painting
4. Section 11005 - Equipment: Basic Requirements.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. ANSI/Hydraulic Institute (ANSI/HI):

- a. 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region.
- b. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
- c. 9.6.6, Rotodynamic Pumps for Pump Piping.
- d. 11.6, Rotodynamic Submersible Pump for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
- e. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

B. Coordinate all mechanical seal systems specified to ensure pump and seal compatibility.

C. Pump/motor and VFD coordination: See Specification Section 11005.

1.03 DEFINITIONS

A. The abbreviations used in this section are defined as follows:

1. AOR: Allowable Operating Range.
2. BEP: Best Efficiency Point.

3. IPS: Iron Pipe Size.
 4. NPSH3: Net Positive Suction Head for 3 PCT head loss.
 5. POR: Preferred Operating Range.
 6. TDH: Total Dynamic Head.
 7. TEFC: Totally Enclosed Fan Cooled.
 8. VFD: Variable Frequency Drive.
- B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.04 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.
 2. See Specification Section 11005.
 3. Product technical data including:
 - a. Performance data and curves with flow (gpm), head (FT), horsepower, hydraulic efficiency, rotating speed (rpm), AOR, BEP, POR, NPSH3 requirements, minimum bowl submergence requirements for vertical mixed flow, axial and turbine pumps.
 - b. Pump accessory data.
 - c. Bearing supports, shafting details and lubrication provisions.
 - 1) Bearing life calculations.
 - 2) Critical speed calculations.
 - d. Solids passage information.
 4. Certifications:
 - a. Certified pump performance curves as described in the SOURCE QUALITY CONTROL Article.
 - b. Verification of Primary and Secondary conditions in POR and AOR.
 5. Test reports:
 - a. Factory hydrostatic test.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:

- a. See Specification Section 01430 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Informational Submittals:

1. Certifications:

- a. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Pumps:

- a. See Specification 11076 for submersible pumps.
- b. Sump pumps:
 - 1) Zoeller.
 - 2) Ebara.
 - 3) Or approved equal.

2. Mechanical seals:

- a. Chesterton.
- b. John Crane.
- c. Garlock.
- d. Or as noted in the individual pump Specification Sections.

3. Seal water station:

- a. Chesterton.
- b. John Crane.
- c. AESSEAL.

- B. Submit request for substitution in accordance with Specification Section 01640.

2.02 SUMP PUMP DESIGN

- A. Sump Pumps:

1. Design Condition:

- a. Flow: 40 GPM.
 - b. Head: 16 FT.
 - c. Minimum motor horsepower: 0.25
2. Pump configuration: Submersible.
 3. Discharge diameter: 2 IN.
 4. Drive type: Constant speed.
 5. Motor electrical: 120 V, 1-phase.
 6. Operating sensor: Float switch.

B.

2.03 ACCESSORIES

A. See Specification Section 11005.

B. Each Unit:

1. Lifting eye bolts or lugs.
2. Plugged gage cock connection at suction and discharge nozzles.
3. Tapped and plugged openings for casing and bearing housing vents and drains.
4. Fittings for properly adding flushing lubricant.
5. Pressure relief fittings for grease lubrication.

C. Packing Seal:

1. Provide packing unless mechanical seal is specified in narrow-scope pump sections.
2. Minimum of five (5) rings graphite impregnated synthetic packing.
3. Provide minimum 1/4 IN DIA supply tap and 1/2 IN DIA minimum drain tap.
4. Provide split Teflon or bronze water seal ring.
5. Adjustable split follower cast iron or bronze gland.

D. Mechanical Seals:

1. Provide as specified in the narrow-scope pump sections.
2. Provide stationary balanced O-ring type.
3. Provide water lubrication - cooling .
4. Materials:

- a. Metal parts except springs: 316 stainless steel.
 - b. Springs: Hastelloy C.
 - c. Seal faces: Unfilled carbon graphite versus silica-free Grade 99.5 ceramic.
 - d. Elastomers: Viton.
- E. Seal Water Station:
- 1. Provide one (1) unit per pump with manual shut-off valve on all pumps with seals.
 - 2. Features:
 - a. Pressure regulating.
 - b. Flow regulating.
 - c. Cleanable flow tube(s) while in service.
 - d. Hose barb connection.
 - e. Liquid filled pressure gage.
 - 3. Materials of construction:
 - a. Flowmeter tubes: Polysulfone.
 - b. Unit body: Polyoxymethylene.
 - c. Pressure gage: 316 stainless steel case and wetted parts.
 - d. Pressure regulating valve: 316 stainless steel.
 - e. Flow regulating valve: 316 stainless steel.
 - f. Tube fittings: 316 stainless steel.
 - g. Mounting brackets: 316 stainless steel.
 - 4. Service:
 - a. Temperatures up to 150 DEGF.
 - b. Pressure up to 140 PSIG.
 - 5. Connection:
 - a. Hose barb threaded to pump.
 - b. Hose barb to seal water unit.
 - c. Reinforced polyurethane hose:
 - 1) Minimum size: 3/8 IN ID.
 - 2) Minimum pressure rating:

- a) At 180 DEGF: 115 PSI.
- b) At 73 DEGF: 200 PSI.
- 3) Minimum wall thickness: 1/8 IN.

6. Mounting:

- a. To pump or pipe flange with stainless steel bracket.
- b. Maximum distance from non-potable water to shut-off ball valve to seal water station and seal water station to pump seal, 2 FT each direction.

2.04 FABRICATION

A. Pump Support:

- 1. Design base to support weight of drive, shafting and pump.
- 2. Comply with HI vibration limitations.
- 3. Mount horizontal pump, motor and coupling on single piece drip lip type baseplate.
- 4. Mount vertical pumps on single piece pedestal baseplate.
- 5. Fabricate to withstand all operating loads transmitted from the pump and drive.
- 6. On vertically configured end suction centrifugal pumps when supplied with a fabricated steel mounting frame and suction elbow, the suction elbow shall be a long radius reducing elbow with greater than 50 PCT area reduction to comply with Table 9.6.6.3.2 of ANSI/HI 9.6.6 standard for straight pipe lengths.

2.05 SOURCE QUALITY CONTROL

- A. Verification primary design condition in POR.
- B. Verification secondary design condition in AOR.
- C. Factory hydrostatic test all pumps at 150 PCT of shut-off head for a minimum of 5 minutes.
- D. If specifically required in the individual pump specification sections, provide factory tests:
 - 1. All units:
 - a. Conduct tests in accordance with HI.
 - 1) Shut-off head and design condition: Positive unilateral performance tolerance meeting Grade 1U per ANSI/HI 14.6 for Rotodynamic Pumps.
 - 2) Shut-off head and design conditions: Positive unilateral performance tolerances meeting Grade 1U per ANSI/HI 11.6 for Rotodynamic Submersible Pumps.
 - 2. All pumps:

- a. Head (FT) versus flow (gpm) pump curves:
 - 1) Efficiencies along curve.
 - 2) Brake horsepower along each curve.
3. Results certified by a registered professional engineer.
- E. Statically and dynamically balance each pump per ANSI/HI standards.
 1. If specifically required in the individual pump specification sections or in Specification Section 11005, field vibration test pumps:
 - a. To meet requirements of ANSI/HI 9.6.4 for Rotodynamic Pumps at any point on the pumps and motor.
 - F. To meet requirements of ANSI/HI 11.6 for Submersible Pumps.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. See Specification Section 11005.
- B. Submersible Units:
 1. Assemble connecting piping with gaskets in place and minimum of four (4) bolts per joint installed and tightened.
 - a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
 - b. Realign as necessary, install flange bolts and make equipment connection.
 2. Field paint units as defined in Specification Section 09900.
 3. Provide discharge pressure gage visible from grade or operating floor.

3.02 FIELD QUALITY CONTROL

- A. Provide services of equipment manufacturer's field service representative(s) to:
 1. Inspect equipment covered by this Specification Section.
 2. Supervise pre-start adjustments and installation checks.
 3. Conduct initial start-up of equipment and perform operational checks.

END OF SECTION

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SECTION 11076

PUMPING EQUIPMENT - SUBMERSIBLE END-SUCTION PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Submersible sewage pumps in a wet pit application for pumping of screened stormwater.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 00 - Procurement and Contracting Requirements.
2. Division 01 - General Requirements.
3. Section 05531 - Grating, Floor Plates and Access Hatches.
4. Section 09900 – Painting.
5. Section 11005 - Equipment – Basic Requirements.
6. Section 11060 - Pumping Equipment: Basic Requirements.
7. Section 16000 – Basic Electrical Requirements.
8. Section 16123 - Low Voltage Wire and Cable.
9. Section 16267 - Reduced Voltage Solid State Starters – Low Voltage.
10. Section 16442 - Motor Control Equipment.
11. Section 17120 – Programmable Logic Controllers.
12. Section 17510 – Cabinets and Panels.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Bearing Manufacturers Association (ABMA).
2. American National Standards Institute (ANSI).
3. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
4. FM Global (FM).
5. Hydraulic Institute (HI):

- a. Standards for Centrifugal, Rotary and Reciprocating Pumps.
- 6. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 7. National Fire Protection Agency (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 500, Hazardous (Classified) Locations, Classes I, II, and III, Divisions 1 and 2.
- 8. Underwriters Laboratories, Inc. (UL).
 - a. 62, Flexible Cord and Fixture Wire.

1.03 SYSTEM DESCRIPTION

- A. Provide three new submersible stormwater pumps installed in the new pump station. The pumps shall be controlled to start/stop based on the water level in the wet well, as shown in the Drawings. Pump discharge diameter shall be 14-inch with 16-inch diameter discharge line to a 30-inch diameter header and stormwater main system. The normal mode of operation is to have all three pumps as duty pumps, with all pumps being operated through rotation to maintain equal run time among the three pumps. All three pumps are to have identical flows and heads, as well as interchangeable spare parts.
- B. Provide single source coordination responsibility through the pump manufacturer for the entire system including but not limited to the following:
 - 1. Pumps.
 - 2. Motors.
 - 3. Reduced Voltage Solid State Soft Starters.
 - 4. Pump accessories, including discharge elbow, rails, lifting chain, power cables,

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01300 for requirements for the mechanics and administration of the submittal process.
 - 2. Requirements in Specification Section 11005.
 - 3. Requirements in Specification Section 11060.
 - 4. Requirements in Specification Section 16267.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01430 for requirements for:

- a. The mechanics and administration of the submittal process.
- b. The content of Operation and Maintenance Manuals.

C. Project Information:

1. Executed Manufacturer's Installation Certification Form.

1.05 SHIPPING

- A. Per Section 11005.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Flygt
 2. Or approved equal.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Pump service category and tag number:
 1. Shutoff Head (range): 72 FT to 74 FT.
 2. Design Condition for Single Pump Operating:
 - a. Flow: 9,150 GPM.
 - b. Head: 20.0 FT.
 - c. Minimum Hydraulic Efficiency: 65 PCT.
 - d. Maximum NPSHR: 26.4 FT.
 3. Runout Condition for Single Pump Operating:
 - a. Minimum Flow: 10,000 GPM.
 - b. Maximum Head: 14.0 FT.
 4. Secondary Condition for Single Pump Operating (for Curve Definition):
 - a. Maximum Flow: 6,350 GPM.
 - b. Minimum Head: 39 FT.
 - c. Minimum Hydraulic Efficiency: 83 PCT.
 5. Design Condition for Three Pumps Operating:

- a. Flow: 16,200 FT.
 - b. Head: 44 FT.
 - c. Minimum Hydraulic Efficiency: 80 PCT.
 - d. Maximum NPSHR: 12.3 FT.
6. Secondary Condition for Three Pumps Operating (for Curve Definition):\
- a. Maximum Flow: 17,460 GPM.
 - b. Minimum Head: 42 FT.
 - c. Minimum Hydraulic Efficiency: 81 PCT.
7. Minimum Discharge Diameter: 14 IN.
8. Pump Rotation: Clockwise rotation when viewed from the driver end.
- a. Motor requirements:
 - 1) Maximum Operating Speed: 885 RPM.
 - 2) Minimum Operating Speed: 885 RPM.
 - 3) Service factor: 1.15.
 - 4) Minimum motor efficiency at the Design Condition: 91 PCT.
 - 5) Minimum power factor: 79 PCT.
 - 6) Maximum nameplate horsepower: 90.
 - b. Drive type: Constant speed.
 - c. Ambient conditions:
 - 1) Stormwater maximum temperature: 100 DEGF.
 - 2) Air maximum temperature: 110 DEGF.
 - d. Cooling type: Cooling jacket

2.03 MATERIALS

- A. Pump Service Category and/or Tag Number:
 - 1. Pump case: Cast iron, ASTM A48, Class 35.
 - 2. Motor housing: Cast iron, ASTM A48, Class 25 or Class 30.
 - 3. Impeller:
 - a. Cast iron, ASTM A48, Class 30.
 - b. Self-cleaning Impeller, N Type

4. Shaft: Stainless Steel, Series 300 or 400.
5. Wear Surfaces: Hardened Stainless Steel, ANSI Series 400, wear rings with the stationary ring harder than the rotating ring.
6. O-rings: Nitrile (Buna-N) or fluorocarbon (Viton).
7. Fasteners: 304 or 316 Stainless steel.
8. Lower ring seal: Tungsten-carbide both faces or Silicon Carbide both faces.
9. Upper ring seal: Tungsten-carbide both faces or carbon and ceramic or carbon and Ni-resist.
10. Seal metal parts: Stainless steel.

B. Wet Pit Applications:

1. Guide rails: Type 316 Stainless steel.
2. Lifting chains and cables: Type 316 Stainless steel.
3. Base elbow: Cast iron, ASTM A48, Class 35.

2.04 COMPONENTS

A. General:

1. Provide pumps capable of handling unscreened stormwater.
2. Where watertight sealing is required, machine and fit mating surfaces with O-rings.
3. Provide with heavy duty lift lugs or hoisting bail designed for lifting the entire pump and motor assembly.

B. Impeller:

1. Provide non-clog solids-handling type dynamically balanced impeller in accordance with HI standards.
2. Provide impeller and volute wear rings as necessary to assure efficient sealing between volute and impeller.

C. Shaft:

1. Design pump shaft of sufficient size to transmit full driver output.
2. Use shaft which is accurately machined and constructed with sufficient materials.
3. Design shaft for a maximum deflection of 0.002 IN at the stuffing box as calculated at the design condition.

D. Mechanical Seal:

1. Seal shaft with two independent double mechanical seal running in an oil filled chamber.

2. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
3. Hold interface in contact by its own spring system.

E. Bearings:

1. Support shaft on upper and lower permanently lubricated bearings with a minimum ABMA L-10 life of 100,000 HRS.

F. Motors:

1. Provide pump with FM, UL, or CSA listed motor approved for Class I, Division I rated area.
2. Provide induction type motor with a squirrel cage rotor, of totally submersible design without loss of watertight integrity to a depth of at least 65 FT, constructed with epoxy or poly-seal encapsulated windings, air-filled or dielectric oil filled, with Class H insulation rated for 180 DEGC and rated for continuous duty operation.
3. Motor shall be 3 PH, 60 cycle, 460 V.
4. Motor shall be capable of running continuously in an unsubmerged condition while pumping under load without damage to motor or seal.
5. The motor horsepower provided shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through runout.
6. The motor shall be designed and assembled by the same manufacturer as the pump.
7. The motor shall be equipped with a closed loop cooling system where the cooling medium is circulated through the pump motor cooling jacket. The pumped fluid shall not be circulated through the cooling jacket. An impeller in the lower motor coolant reservoir will circulate coolant around the motor housing. The cooling system shall provide sufficient cooling for continuous operation whether the pump is submerged in the pumped media or surrounded by air in liquid or ambient temperatures of up to 40 DEGC.
8. Cooling system will provide sufficient cooling for the entire range of pump operating speeds.

G. Power and Control Cables:

1. Provide power and control cables which are listed per NEC requirements and approved for the installation types indicated on the drawings. As a minimum the cable shall be suitable for installation in conduit and for submersible applications.
2. Size cables in accordance with applicable NFPA 70 specifications.
3. Provide 80 FT power cable and control cable.

4. Provide each cable with a strain relief, cord grip, and explosion proof seal installed in accordance with NFPA 70, Article 500.
5. Minimum acceptable cable type: "SO-Water Resistant" per UL 62.

H. Pump Protection Relay

1. Furnish a pump protection relay for each pump, mounted in the RVSS enclosure.
2. Pump protection relay to be Flygt MiniCAS II or approved equal.
3. Pump protection relay to provide for the following:
 - a. Temperature Monitoring:
 - 1) Furnish each phase of the motor with thermal switches embedded in the motor windings.
 - 2) Should high temperature be sensed in the windings, the thermal switch will open, shut the pump down, and sound an alarm. Should any one of the thermal switches detect high temperature, it will automatically reset once the stator temperature returns to normal.
 - 3) Set temperature of the temperature monitors not higher than 90 PCT of insulation temperature rating.
 - b. Leak Detection:
 - 1) Provide sensors inside the terminal board and the stator chamber to detect water intrusion
 - 2) If water is detected inside the terminal board or the stator chamber, a switch will stop the pump and sound an alarm.

I. Coatings:

1. Apply two-component oxirane ester or polyamidoamine epoxy system to the exterior of the pump casing and motor housing as specified in Specification Section 09900.

J. Wet Pit Applications:

1. Provide sliding guide bracket integral to pump unit which properly aligns the pump discharge with the discharge connection elbow for watertight seal during pumping.
2. Guide the entire weight of the pumping unit to the base discharge elbow by guide rail(s).
3. The guide rail(s) shall not support any portion of the weight of the pump.
4. Provide chains or cable of sufficient strength to lift pumps from sump.
5. Furnish guiding rail assembly and the discharge flange assembly of nonsparking components.

6. Design pump to allow for removal without entering the wet well and without removal of bolts, nuts or other fastenings.
7. Provide pump unit connecting to discharge connection with a simple downward motion without rotation. The entire weight of the pumping unit shall wedge tightly against the discharge elbow flange forming a seal without the use of bolts, gaskets, or o-rings.
8. Provide necessary sliding guide bracket and discharge connection which, when bolted to the floor of the sump and to the discharge line, will receive the pump discharge connecting flange without need of adjustment, fasteners, clamp, or similar devices.
9. No portion of the pump shall bear directly on the floor.

2.05 ACCESSORIES

- A. See Specification Section 11060 - Pumping Equipment: Basic Requirements.
- B. Controls:
 1. See Electrical and Instrument and Controls Designs for controls requirements.
- C. Access Doors and Frames for Wet Pit Applications:
 1. Doors: See Specification Section 05531.

2.06 SOURCE QUALITY CONTROL

- A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:
 1. Check impeller, motor rating and electrical connections for compliance with this Specification Section.
 2. Test motor and cable insulation for moisture content or insulation defects.
 3. Prior to submergence, run pump dry to establish correct rotation and mechanical integrity.
 4. Run pump submerged for 30 minutes.
 5. After operational test #4, perform insulation test (#2) again.
- B. Factory test of head (FT) versus flow (GPM) for all pumps being provided as specified in Specification Section 11060.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. See Specification Section 11060.

- B. For wet pit pumps, permanently install discharge connection elbow in wet well along with discharge piping.
- C. Seal pump cable end with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

3.02 FIELD QUALITY CONTROL

- A. See Specification Section 11060.

END OF SECTION

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SECTION 13101
LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Lightning protection systems using lightning rods.

B. Scope:

1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals necessary and required to provide lightning protection systems of the type indicated.
2. Contractor shall furnish the services of individual possessing required qualifications, as indicated in this Section, to prepare the final design of the lightning protection systems required, in accordance with this Section and other Contract Documents. Such services are not delegated design.
3. Provide lightning protection systems for the following buildings and structures:
 - a. Pump Station Electrical Building.
 - b. Generator

C. Related Requirements include but are not necessarily limited to:

1. Section 16060 - Grounding and Bonding.

1.02 REFERENCES

A. Terminology: In this Section and relative to lightning protection system Work, the terminology indicated below has the following meaning, regardless of whether indicated with initial capital letters:

1. Classification of Buildings in accordance with NFPA 780:
 - a. Class I: Any commercial, industrial, or residential building less than 75 feet in height.

B. Reference Standards:

1. ASTM International (ASTM):
 - a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
2. Lightning Protection Institute (LPI):

- a. 175, Standard for the Design - Installation - Inspection of Lightning Protection Systems.
3. National Fire Protection Association (NFPA):
 - a. 780, Standard for the Installation of Lightning Protection Systems.
4. National Electrical Manufacturers Association (NEMA):
 - a. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
5. Underwriters Laboratories, Inc. (UL):
 - a. 96, Standard for Safety Lightning Protection Components.
 - b. 96A, Standard for Installation Requirements for Lightning Protection Systems.
 - c. 651, Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordination – General:
 - a. Contractor shall coordinate the services of lightning protection system designer with all other elements of the Work.
 - b. Contractor has full responsibility for scheduling lightning protection system designs and all related Work.
 - c. Allow sufficient time in Progress Schedule for performance of lightning protection system services, including requests for interpretation or clarification between lightning protection system designer and Contractor and between Contractor and Engineer.
2. Coordination of Lightning Protection System Work's Connections to Other Work:
 - a. Where lightning protection system Work connects to other Work designed by Engineer, existing construction, or both, the lightning protection system Work shall be consistent with the other Work and existing construction to which lightning protection system Work connects, and adjacent construction.
 - b. Submit details, loading, anchorage, and other coordinating information necessary for the lightning protection system Work to properly interface with Work designed by Engineer.
 - c. Changes in the Work, whether designed by Engineer, designed by lightning protection system designer, or existing construction, necessary as a result of the lightning protection system are ineligible for increase in Contract Price or Contract Times, unless: (1) otherwise agreed by both Engineer and Owner, or (2) expressly indicated otherwise elsewhere in the Contract Documents for the lightning protection system Work.

- d. Changes requiring extra compensation, time, or both arising from lightning protection system design aspects needed for convenience of Contractor, Subcontractor, or Supplier, are not grounds for increase in Contract Price or Contract Times.
3. Coordination of Submittals, Fabrication, Production, and Shipment:
 - a. Do not release for raw materials procurement, fabrication, production, and shipment to the Site materials, equipment, or systems designed by lightning protection system designer until the associated lightning protection system designer has completed the design and Engineer has reviewed and approved all associated Shop Drawings, product data Submittals, Samples, and such Submittals have been delivered to and accepted by Engineer.
 - b. Allow sufficient time in the Progress Schedule for required Submittals and required actions by lightning protection system designer and Engineer.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Lightning Protection System Designer:
 - a. One individual, acceptable to Engineer, shall design or directly supervise preparation of the final design of all lightning protection systems required for the Work.
 - b. Individual preparing, or directly supervising preparation of, final design of lightning protection systems shall possess current, valid "Designer Inspector" (DI) certification from Lightning Protection Institute (LPI) or "Lightning Protection Master Certification" (LPMC) from Underwriters Laboratories (UL).
 - c. In addition, individual performing, or directly supervising preparation of, final design of lightning protection system shall be able to furnish documentation indicating possession of not less than ten years' experience personally designing or supervising the preparation of lightning protection systems similar to that required for the Work.
 - d. Designer may be employee of lightning protection system Supplier or individual or entity retained by lightning protection system Supplier.
 - e. Submit to Engineer copy of current certification as LPI DI or UL LPMC and record documenting experience of lightning protection system designer. Indicate designer's current employer and employment history.
 - f. Upon Engineer's request, submit information for not less than five prior lightning protection systems, similar in type, scope, and extent to that required for the Work. Construction of each lightning protection system on each such project shall have been substantially complete for not less than one year at the time such documentation is submitted to Engineer. Such information shall include, for each project, the following: project name and location (city, state or province, country); project owner; designer's employer and their role in the project (prime contractor, subcontractor, or supplier); name of project's design

professional (company name) and location; year lightning protection system was completed; and general description of scope and extent of lightning protection system work.

2. Installer:

- a. Installer of lightning protection system may be Contractor or Subcontractor.
- b. Throughout the Work, installer shall be a current, "UL Listed Lightning Protection Contractor".
- c. Installer's project manager or site superintendent shall possess a current, valid certification as "Master Installer" from LPI. Such individual shall be actively involved in managing and supervising installation of the lightning protection system Work.
- d. Installer shall furnish valid "UL Master Label" for the substantially completed lightning protection system Work.
- e. In addition, installer shall possess not less than five years' relevant experience performing lightning protection system construction and shall be able to document not less than five completed, prior projects or similar scope and complexity to the lightning protection system Work within the most-recent five-year period.
- f. Submit to Engineer documentation of installer's current status as "UL Listed Lightning Protection Contractor" and copy of required LPI "Master Installer" certification.
- g. Upon Engineer's request, submit documentation of required experience.

1.05 SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings:

- a. Drawings of entire lightning protection system for each building and structure for which lightning protection system is required. Include plans, sections, schematics, and details as appropriate.
- b. Plan drawings showing type, size, and locations of all lightning protection materials and equipment. Roof penetration detail drawings.
- c. Submit schedules (tables) of materials and equipment as appropriate, indicating type, size, materials, and location of each, together with other pertinent information.
- d. "Certificate of Compliance" by lightning protection system designer, in accordance with this Section's Article, "Responsibilities of Lightning Protection System Designer".

2. Product Data:

- a. Data for all materials and equipment required by “Part 2 – Products” of this Section. Submit material and equipment manufacturers’ published product data such as catalog pages, standard drawings, expected performance data, specifications, and the like.
 - b. Submit data sheets that include manufacturer’s name and product model number. Clearly identify all optional accessories.
 - c. Certification that materials and equipment proposed submitted are in accordance with applicable standards of LPI or UL.
- B. Informational Submittals: Submit the following:
1. Certifications and Notices:
 - a. Roofing system manufacturer written consent to installer’s proposed penetrations (if any) through roofing system.
 2. Roofing System Manufacturer’s Instructions:
 - a. When Contractor proposes mechanically fastening lightning protection system components to, or providing penetrations through, roofing, obtain and submit to Engineer the roofing system manufacturer’s:
 - b. Written concurrence with proposed installation methods.
 - c. Written instructions for sealing penetrations into or through roofing system.
 3. Supplier’s Instructions:
 - a. Manufacturer’s written instructions for handling, storage, and installation for all materials and equipment furnished.
 4. Field Quality Control Results:
 - a. Submit results of field quality control activities required in this Section.
 5. Supplier’s Reports:
 - a. Submit written report of each visit to the Site by manufacturer’s factory-trained representative.
 - b. Submit written report of each visit to the Site by lightning protection system designer.
 6. Qualifications Statements:
 - a. Lightning protection system designer.
 - b. Installer.
- C. Closeout Submittals: Submit the following:
1. Post-Installation Certifications:

- a. Installer's written certification that the substantially completed lightning protection system Work complies with the Contract Documents.
 - b. "UL Master Label" certificate.
2. Operation and Maintenance Data:
- a. Manufacturer's operation and maintenance manual for each building's or structure's lightning protection system provided or modified. Comply with Section 01430 - Operation and Maintenance Data.
 - b. Indicate requirements for, and frequency of, periodic inspections.
3. Record Documents:
- a. Prepare and submit drawings, including plans of roof or top of each building and structure for which lightning protection system was provided or modified, indicating as-constructed conditions. Include appropriate sections, details, and schematics.
 - b. Record drawings shall expressly indicate their status as "as-constructed" drawings with an appropriate revision date.

1.06 RESPONSIBILITIES OF LIGHTNING PROTECTION SYSTEM DESIGNER

- A. Responsibilities of lightning protection system designer employed on the Work include, but are not necessarily limited to, the following, unless specifically indicated otherwise in the associated elements of the Contract Documents where the lightning protection system is required:
1. Ethical Conduct and Professionalism: Comply with Laws and Regulations, and standards and guidelines regarding codes of ethics and codes of conduct published by relevant industry organizations, including LPI and UL.
 2. Comply with Laws and Regulations and relevant design standards applicable to the subject lightning protection system Work.
 3. Performance and Design Criteria Indicated in the Contract Documents and Other Information:
 - a. Review performance and design criteria, indicated in the Contract Documents, that the lightning protection system Work must satisfy.
 - b. Prepare written requests for interpretations or clarifications of performance or design criteria.
 - c. Review existing information about the Site that constitutes Technical Data (if any, applicable to the subject lightning protection system Work), as indicated in the Supplementary Conditions.
 4. Site Information and Investigations: With Contractor, obtaining all other necessary dimensions, field information, and other information necessary for preparing lightning protection system Shop Drawings.