CITY OF SWEET HOME

CONTRACT DOCUMENTS

FOR

MAHLER WATER RECLAMATION FACILITY IMPROVEMENTS PROJECT PHASE 1

VOLUME 2 OF 3

TECHNICAL SPECIFICATIONS DIVISIONS 02-46

BID DOCUMENTS

Department of Public Works, Engineering Division
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AUGUST 2022

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CITY OF SWEET HOME
MAHLER WRF IMPROVEMENTS PROJECT
PHASE 1

SECTION 00 01 10 – TABLE OF CONTENTSFOR

VOLUME 1 of 3

Division 00 – Procurement and Contracting Requirements

Division 01 - General Requirements

VOLUME 2 of 3

Division 43 – Process Gas and Liquid Handling, Purification, and Storage

Division 46 – Process Gas and Liquid Handling, Purification, and Storage

VOLUME 3 of 3

Volume 3 Drawings

SUPPLEMENTARY INFORMATION (Under Separate Cover)

McMillen Jacobs Associates*, Geotechnical Data Report – City of Sweet Home, Mahler Water Reclamation Facility Improvements*, Final June 2022

END OF SECTION

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SECTION 02 41 00

DEMOLITION, SALVAGE AND ABANDONMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Demolition, salvage, and abandonment of existing facilities.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 31 00 00 – Earthwork

1.03 SUBMITTALS

A. Comply with Section 01 33 00.

B. Description of removal procedures for careful removal of materials and equipment and the protection of facilities which are to remain undisturbed.

C. Time schedule for demolition work. Show demolition in relation to new construction, including any temporary facilities.

1.04 EXISTING CONDITIONS

A. Prior to the submittal of Bids, Contractor shall visit the site and inspect all facilities to become familiar with existing conditions and utilities.

1.05 REGULATORY REQUIREMENTS

A. Dispose of debris offsite in accordance with the requirements of agencies having jurisdiction.

B. Comply with applicable air quality control regulations.

C. Obtain necessary permits for building demolition, transportation of debris to disposal site(s) and dust control.

D. Erect appropriate safety devices to protect the general public, Owner's operations personnel, and workers from the hazards of demolition activities. Install barriers, guard rails and fences, and provide appropriate warning signs.

1.06 BURNING

A. The use of burning at the project site for the disposal of refuse, debris, and waste materials will not be permitted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. The Drawings identify the major equipment and facilities to be demolished, salvaged, or abandoned. Auxiliary utilities such as water, air, drainage, lubrication oil, electrical wiring, controls, and instrumentation are not necessarily shown. Remove auxiliary utilities, as well as equipment and pipe supports and associated instrumentation devices pertaining to piping or equipment designated to be removed.

3.02 PROTECTION OF EXISTING FACILITIES

A. Before beginning any cutting, trenching, or demolition work, carefully survey the existing work and examine the Contract Documents to determine the extent of the Work.

B. Take precautions to prevent damage to facilities which are to remain in place or are to be salvaged, and be responsible for any damages to these facilities resulting from this work. Repair or replace damages to such work to return the facilities to its pre-existing condition at no additional cost to the Owner.

3.03 DEMOLITION

A. Demolish structures and equipment in an orderly and safe manner.

B. Dispose of material not identified for salvage or re-installation at a new location.

C. Minimize dust by sprinkling with water.

D. Backfill excavations caused by demolition in accordance with Section 31 00 00.

3.04 SALVAGE

A. Carefully remove and salvage, for reuse by the Owner, items, if any, identified on the Drawings

B. Remove salvage items in their largest pieces that can be easily handled and stored by Owner's personnel. Remove these items from their existing location and deliver them to a location designated by the Owner.

C. Remove items to be salvaged in a workmanlike manner and take the necessary precautions to prevent damage to the materials and equipment.

3.05 BURIED PIPELINES

A. Where buried pipelines are shown to be removed on the Drawings, they may be abandoned in place if there is no conflict with proposed construction and they are not located under or within 10 feet of any proposed structure.

3.06 ASBESTOS CEMENT PIPE

A. Remove and dispose of asbestos cement pipe disturbed during the performance of the Work. Remove and dispose in accordance with all Federal, State, and local laws, regulations, requirements, and guidelines.

B. Notify all appropriate authorities prior to performing work related to removal and disposal of asbestos cement pipe.

C. Provide landfill disposal weight records to Engineer for use as the basis of unit price payment.

D. Where necessary to connect into existing City asbestos cement potable water lines, perform work in accordance with all Federal, State, and local laws, codes, requirements, and guidelines.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. Concrete, site debris, rubbish, and other materials resulting from demolition operations, as well as mechanical and electrical equipment designated to be demolished, shall be the property of the Contractor and shall be legally disposed of at the Contractor's expense.

3.08 CLEANING

A. During and upon completion of the demolition operations, promptly remove unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave work areas in a clean condition.

B. Do not sweep, grade, or flush surplus materials, rubbish, or debris into storm drains, channels, lakes, or streams.

END OF SECTION

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SECTION 03 11 00

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Formwork for cast-in-place concrete, including shoring and form supports, and installation of embedded items.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 03 15 00 – Concrete Accessories
3. Section 03 20 00 – Concrete Reinforcement
4. Section 03 30 00– Cast-in-Place Concrete

1.03 SYSTEM RESPONSIBILITY

A. The design for structural adequacy, engineering, and erection of formwork shall be the sole responsibility of the Contractor.

B. Engineer's review of shop drawings and/or forms installed in place does not relieve the Contractor of their responsibility for adequately designing, constructing, and maintaining the forms so that they will function properly.

C. Removal of the formwork and any resulting structural or finishing damage is the sole responsibility of the Contractor.

1.04 SYSTEM DESCRIPTION

A. Design Criteria: Design formwork and appurtenant items in accordance with ACI 117, ACI 347R, and requirements specified herein.

B. Performance Requirements

1. Tolerances: Construct formwork to achieve the tolerances specified in ACI 347R, and as modified herein for the finished concrete structure:

a. Variation of the linear outline from the established position in plan: 1/2 inch.

b. Departure from level or from the grades shown: +1/2 inch and - 1/2 inch.

c. Departure from plumb or specified batter: (0.3 % X Height) < 1 inch.

d. Variation in thickness of slabs and walls: +1/2 inch and -1/4 inch.

e. Departure in location and size of slab or wall openings: +1/4 inch and -1/4 inch.

f. Abrupt irregularities (using a 5 feet long straight edge): +1/2 inch and -1/4 inch.

2. Do not combine the tolerances specified under the various foregoing categories in the evaluation of a structure element so as to arrive at a total combined tolerance which is greater than that permitted under any single category.

3. Utilize stricter tolerances than those specified as necessary to accommodate manufacturer requirements or standard industry practice for the installation of equipment, structural steel, miscellaneous metals, and items embedded in or otherwise attached to concrete.

1.05 SUBMITTALS

A. Comply with Section 01 33 00.

B. Engineer's review of formwork submittals shall be with regard to ability to achieve surface finish and tolerances.

C. Product Data: Provide manufacturers' data and installation requirements for form materials, form coatings, sealers, release agents, form ties, and other accessories.

D. Structural Calculations

1. Submit structural calculations for formwork design, stamped and signed by a licensed Professional Engineer in Oregon.

E. Shop Drawings

1. Fully dimensioned drawings of fabricated forms showing general arrangement of form panels, including number of sections, length of sections, form windows, ties and sizes of structural members.

2. Indicate locations of construction joints, locations and sizes of openings and blockouts, and identify the following items: materials, bracing, shoring and re-shoring, and arrangement of ties and other accessories.

3. Submit removal sequence diagrams and procedures for form removal.

4. Formwork shall be designed by a licensed Professional Engineer in Oregon and design drawings shall be stamped and signed.

F. Quality Control Plans

1. Methods for assuring that forms are constructed and erected to the lines, grades, and within tolerances specified prior to placing concrete for that pour.

2. Methods for assuring that formed concrete has sufficient strength for erecting and stripping of forms.

3. Methods for achieving required finishes.

1.06 QUALITY ASSURANCE

A. Reference Standards

1. American Concrete Institute (ACI):

a. ACI 117 – Tolerances for Concrete Construction.

b. ACI 347R – Standard Recommended Practice for Concrete Formwork.

c. ACI 301 – Standard Specifications for Structural Concrete.

d. ACI 318 – Building Code Requirements for Structural Concrete.

2. American Plywood Associations (APA)

a. PS 1 US Product Standard for Construction and Industrial Plywood.

B. Installation of Formwork

1. Build, erect and move forms under the supervision of experienced superintendence and craftsmen.

1.07 SEQUENCING AND SCHEDULING

A. Allow sufficient time between erection of forms and placing of concrete for other trades to properly install concrete reinforcement and embedded items.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect, and handle products in accordance with manufacturer's instruction.

B. Store materials in a manner that will prevent any damage or deterioration and allow easy access for inspection and identification of each item.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General

1. Construct forms using materials that are straight, rigid, mortar-tight, and of the correct shape and dimensions. Clean inside surfaces of forms to remove dirt, mortar, and foreign materials.

B. Form Materials for Exposed Surfaces

1. APA grade-stamped "B-B plyform, Class 1, Exterior" Douglas fir plywood.

2. Minimum 3/4 inch thick with reinforcement for the spans and construction loading.

3. Smooth, uniform in size and free of raised grain, torn surfaces, worn edges, patches or other defects; no mill oiling permitted.

4. Exposed corners and edges of concrete shall have a 3/4-inch chamfer.

C. Form Materials for Unexposed Surfaces

1. Made of wood, metal, or other acceptable material.

2. Wood Forms: Constructed of sound lumber or smooth plywood of suitable dimensions, free from knotholes and loose knots.

3. Metal Forms: As acceptable for the class of work involved and of the thickness and design required for rigid construction.

D. Curved Surfaces: Form with metal, plywood, or adequately supported, surfaced and matched Douglas fir boards which are not more than 4-inches wide.

E. Styrofoam: Construction Grade.

F. Formwork Accessories

1. Form Ties: Metal, removable to a depth of at least 1-1/2 inches below the surface of the concrete. At locations of each removal, a uniform and circular hole shall be made and patched. Ties shall be of sufficient strength to prevent the spreading of the forms during concrete placement. The use of wire ties will not be permitted.

2. Chamfer Strips: 3/4-inch fillet milled from clear, straight-grain pine, surfaced each side; or extruded vinyl type with or without nailing flange.

3. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required; of strength and character to maintain formwork in place while placing concrete.

G. Form Release Agent

1. Commercial formulation designed for use on all form facing materials used, which will not:

a. Bond with, stain, or adversely affect concrete surfaces.

b. Impair subsequent treatment of concrete surfaces requiring bond or adhesion.

c. Impede wetting of surfaces which will be cured with water, steam, or curing compounds.

d. Form coatings containing mineral oils or petroleum solvents such as paraffin or other non-drying materials will not be permitted.

e. For metal forms, use specially formulated coatings for metal forms to prevent rust stains on concrete.

H. All other materials not specifically described, but required for proper completion of the concrete formwork, shall be as selected by the Contractor and subject to approval by the Engineer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Conform to considerations and recommendations in ACI 318, Chapter 6.

B. Vertical and Horizontal Controls: Establish and maintain necessary benchmarks, lines, or controls throughout construction.

C. Obtain necessary information and provide for openings, sleeves, recesses, nailers, anchors, ties, inserts, and similar embedded items. Coordinate with concrete and other related work for requirements governing embedment and sleeving of pipes and conduit. Coordinate work with that of Section 03 15 00.

D. Obtain approval from Owner's Representative before framing openings not shown on Structural Drawings.

E. Make arrangements with the Owner's Representative to inspect all formwork and enclosed volume, including the interior of formed area prior to installing the closure

forms, for inspection of the forms, cleanup and preparation of the adjacent surfaces, and in accordance with Section 03 20 00.

F. Check formwork during placing of concrete using tell-tale devices, such as plumb bobs and known offsets, measurements, and other appropriate means, as necessary to detect formwork movements and to verify that the specified tolerances are achieved.

3.02 CONSTRUCTION OF FORMS

A. General

1. Construct formwork to produce concrete surfaces conforming to tolerances in ACI 301.

2. Construct formwork to the exact shapes, lines and dimensions of concrete members, arranged to allow erection in proper sequence and to permit removal without damage to concrete finish.

3. Unless otherwise indicated on Drawings, construct formwork panels in sections as large as practicable. Construct forms of boards or plywood of same widths, shapes, and design for accurate location of form joints as indicated on the shop drawings. Make joints between panels tight to minimize loss of mortar through the joint.

4. Verify clear space between forms to insure allowable coverage for reinforcing steel and allowable tolerances for construction.

5. Forms for walls of considerable height shall be arranged with tremies and hoppers for placing concrete in a manner that will prevent segregation and accumulation of hardened concrete on the forms or reinforcements above the fresh concrete.

6. Provide temporary openings at bottom of forms where necessary in order to facilitate cleaning and inspection before concrete placement. Provide blockouts for mechanical and electrical work wherever necessary.

7. Provide forms for footings wherever concrete cannot be placed against solid earth excavation.

8. Apply approved form coatings, sealers and release agents immediately before erecting forms where necessary to achieve the specified curing and finishes.

B. Framing and Bracing

1. Use framing, bracing and supporting members of ample size and strength to safely carry, without excessive deflection (exceeding allowable tolerances), all dead and live loads to which formwork may be subjected; they shall be placed sufficiently close to prevent any apparent bulging or sagging of forms.

C. Exposed Concrete Surfaces

1. Make plywood panel patterns regular and symmetrical, joints plumb and level, and horizontal joints continuous.

2. Control reuse of forms for exposed surfaces in order to provide a surface of uniform color and texture absent of sharp demarcation between adjacent surfaces.

3. Provide 3/4 inch chamfer at corners of exposed concrete unless otherwise noted. At chamfers, the concrete cover for reinforcement is critical and the minimum specified thickness shall strictly apply.

4. Edges of all form panels in contact with concrete shall meet the required tolerances set forth in Section 3.3 of ACI 347R for Class A surfaces. Form joints shall be tight to prevent the passage of mortar, water, and grout.

D. Embedded Items: Secure all structural inserts, bolts, plates, sleeves and other embedded items.

3.03 APPLICATION OF FORM COATINGS

A. Thoroughly clean forms and coat with approved form coating material prior to initial use and before each reuse. Excess form coating material shall not stand in puddles in the forms nor shall such coating come in contact with hardened concrete against which fresh concrete is to be placed.

B. Apply form coating material before reinforcing steel, anchoring devices and embedded items are placed.

3.04 FALSEWORK

A. Contractor shall be fully responsible for the proper strength, safety and adequacy of the falsework, the supports, and bearing surfaces used on and in connection with the work. Design falsework to support imposed loads without deformation, deflection, or settlement.

B. Use wedges in pairs or jacks where required to maintain and/or adjust forms and formwork for beams, slabs and other parts of the structure at exact elevations. To ensure uniform bearing, single wedges are not permitted. Comply with requirements of ACI 347R.

C. Carry vertical and lateral loads to the ground by the falsework system or by the completed structure after it has attained the requisite strength. Protect falsework supports, when placed on ground, against undermining or settlement.

3.05 REMOVAL OF FORMS AND FALSEWORK

A. Remove forms in such a manner that does not impair safety and serviceability of the structure.

B. Do not remove supports until members have sufficient strength to safely support their own weight and all superimposed loadings with proper factor of safety.

C. Maintain formwork in place until the concrete has attained the minimum percentage of specified design compressive strength specified below.

1. Side forms for footings, foundations, slabs on grade, or other components that do not resist bending: Do not remove until the concrete has attained 25% of the specified 28-day compressive strength.

2. Forms supporting concrete beams, suspended and cantilevered slabs, walls, or other members subject to bending stress: Do not remove until the concrete has attained 90% of specified 28-day compressive strength.

a. Do not load such members until the concrete has attained its specified 28-day compressive strength.

D. Remove forms, supports, and falsework without hammering or prying against the concrete.

E. Remove fins and other projections as soon as the forms have been stripped.

F. After forms have been removed, examine concrete surfaces to identify defects and repair defects and irregularities in surfaces and finishes as specified in Section 03 30 00.

G. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.

3.06 REUSE OF FORMS

A. Clean and repair surfaces of forms that will be reused. Renew form release coating as specified for new formwork.

B. Patch holes and defects in forms with materials and methods that will not be reflected in concrete.

C. Do no reuse forms with split, frayed, delaminated, or otherwise damaged facing material. Remove such material from the site.

END OF SECTION

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SECTION 03 15 00

CONCRETE ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Accessories for cast-in-place concrete.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 03 11 00 – Concrete Formwork
3. Section 03 20 00 – Concrete Reinforcement
4. Section 03 30 00– Cast-In-Place Concrete

1.03 DEFINITIONS

A. Construction Joints: When fresh concrete is placed against a concrete surface, with or without reinforcement, the joint between the two pours is called a construction joint.

B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete is not bonded to the hardened surface of the first pour. In addition, the hardened surface of the first pour is coated with a bond breaker.

C. Expansion Joints: Expansion joints allow the concrete to expand freely with changes in temperature by providing a space between the two pours. This space is obtained by placing premolded expansion joint material against the first pour, then removing this material after the second pour to create the space.

D. Control Joints: The function of the control joint is to provide a weaker plane in the concrete, where shrinkage cracks are likely to occur. The control joint is formed or saw-cut in the concrete.

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Product Data

1. Manufacturer's data for accessories, including installation and application instructions, and material safety data sheets.

1.05 PERFORMANCE REQUIREMENTS

A. Hydrophilic Waterstops: Designed to expand in the presence of water to form a watertight joint without damaging the concrete in which it is cast.

1.06 QUALITY ASSURANCE

A. Reference Standards

1. American Concrete Institute (ACI) – ACI 504R: Guide to Joint Sealants for Concrete Structures.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Transport, store and handle concrete accessories according to manufacturer's written instructions, and such that damage, including weather damage, is prevented.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Caulking Compound

1. Manufacturers: One of the following, or equal:

a. Dow Corning, 790 Silicone Building Sealant.

b. Bostik, Chem-Caulk 1250.

B. Joint Sealing Compound

1. Cold applied, field molded, nontoxic.

2. One or two component polysulfide sealant.

3. Conform to Federal Specification TT-S-00227E, Class A, Type 1 or Type 2.

4. Non-sag type for overhead vertical and sloping applications; self-leveling type elsewhere.

C. Preformed Expansion Joint Filler

1. Self-expanding cork type joint filler composed of granulated cork particles, resin-bonded into board form, compressed and dehydrated under heat and pressure and capable of expanding up to 140% of the original thickness after installation due to the re-absorption of moisture.

2. Conform to ASTM D 1752, Type III.

D. PVC Waterstops

1. Material: Extruded from an elastomeric polyvinyl chloride compound.

2. Type: Use center-bulb type waterstops unless alternative design is specifically indicated on the Drawings.

3. Physical properties of sheet material shall be as follows:

a. Minimum Tensile Strength per ASTM D638, Type IV: 1750 psi.

b. Ultimate Elongation per ASTM D638, Type IV: 350 percent.

c. Maximum Low Temperature Brittleness per ASTM D746: -35 degrees F.

4. Manufacturers: Greenstreak, Inc., Kirkhill Rubber Company, W.R. Grace, or equal.

E. Hydrophilic Waterstops

1. Swellable, polyurethane/butyl rubber waterproofing compound with adhesive backing for adhering to concrete surfaces.

2. Manufacturers: One of the following, or equal:

a. "Hydrotite" as manufactured by Greenstreak, Inc.

b. Adcor ES as manufactured by Grace Construction Products.

F. Plastic Crack Control Strips

1. Crack control (zip) strips used as joint formers shall be designed to provide positive control of transverse construction or expansion joints.

2. Plastic, two-part assembly designed to permit removal of the top portion after the concrete has hardened, thereby creating a clean, neatly defined void for application of caulk or sealant as specified.

3. Provide 1-inch, 1-1/2 inch, and 2-inch strips as applicable.

4. Manufactured by BoMetals, Inc. or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Locate construction joints in concrete at points indicated on the Drawings.

B. Concrete Formwork: In accordance with Section 03 11 00.

C. Concrete Reinforcement: In accordance with Section 03 20 00.

D. Cast-in-Place Concrete: In accordance with Section 03 30 00.

3.02 APPLICATION

A. Caulking Compound

1. Preparation of Joint: Clean joint surfaces immediately before application of caulk. Roughen and prime joint surfaces as recommended by the caulk manufacturer.

2. Application of Caulking Compound: Apply caulk according to the manufacturer's recommendations. Completely fill the joint groove around the entire perimeter of each opening.

3. Cleaning: Clean the surfaces of materials adjacent to sealed joints from smears of caulking compound or other soiling resulting from the caulk application.

B. Joint Sealing Compound

1. Conform to the requirements of ACI 504R.

2. Preparation of Joint: Dry joints by application of heat. Fill joints immediately following the curing period or as soon thereafter as weather conditions permit. Immediately before filling, clean the joint of all dust, dirt fragments, concrete or other objectionable material by a light air blasting or other approved methods.

3. Application of Cold Applied Joint Sealing Compound: Store each component of joint sealing compound in its respective container and unbroken until

immediately prior to usage. Mix joint compound to form a thick paste. Follow the manufacturer's written instructions for mixing and applying joint sealing compound.

C. Preformed Expansion Joint Filler

1. Install joint filler against walls, at interrupting objects or columns, and against abutting structures.

2. Install joint filler with top of filler 1/2 inch below concrete finish level.

3. Place cap over the expansion joint prior to placing concrete, remove cap after concrete has cured.

3.03 PVC WATERSTOPS

A. General Installation Requirements

1. Use type of waterstop indicated on the Drawings or specified in this Section.

2. Position waterstop across the concrete joint.

3. Make waterstops fully continuous for the extent of the joint, making splices as necessary to provide such continuity.

B. Splices

1. Utilize factory manufactured joints, tees, and crosses and field splice to straight lengths of waterstop.

2. Field Splices: Make splices in straight runs of waterstop by heat sealing edges of adjacent waterstop sections in accordance with the manufacturer's printed recommendations. Do not damage the waterstop material in the welding procedure.

3. Tensile Strength of Splice: Not less than 60 percent of the tensile strength of the parent material.

4. Maintain continuity of the waterstop ribs and center bulb through the splice.

C. Installation

1. Install waterstops in the vertical and horizontal construction joints and control joints as indicated on the Drawings.

2. Correctly position waterstops across the concrete joint by centering the waterstop within the joint.

3. Anchor the waterstops to maintain proper embedment and position in the concrete.

a. Using light wire ties on 12-inch centers that pass through the edge of the waterstop and are tied to the curtain of reinforcing steel.

b. Hold horizontal waterstops in place with continuous supports to which the top edge of the waterstop is be tacked.

4. Stop waterstops in vertical wall joints 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.

D. Concrete Placement Around Waterstops

1. Thoroughly work the concrete in the vicinity of waterstops to insure maximum density and imperviousness of the concrete and to prevent the formation of air and rock pockets.

3.04 HYDROPHILIC WATERSTOPS

A. Install hydrophilic waterstop in accordance with manufacturer's recommendations.

B. Clean surfaces prior to installation.

C. On irregular surfaces and where necessary to provide a complete seal, apply waterstop in a bead of adhesive and allow to dry.

D. Center waterstop in the concrete joint and press waterstop firmly into place.

E. Secure waterstop using powder driven nails at 12 inches on centers.

F. Lap 3-inch at splices with full contact between joined surfaces.

END OF SECTION

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SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel bars and associated accessories for use in cast-in-place concrete.

1.02 SUBMITTALS

A. Product Data:

1. Reinforcement: Submit reinforcing steel manufacturer's data.

B. Shop Drawings:

1. Submit reinforcing rebar fabrication drawings, prepared in accordance with ACI 315. Indicate list of materials, sizes, and dimensions.

2. Submit reinforcement placement drawings indicating bar size, spacing, layout, placement details, splicing lengths, and lap lengths. Placement drawings shall not consist of, or contain, reproductions of the Contract Drawings.

3. Review of Placement Drawings

a. Engineer's review of reinforcement placement drawings will be for general compliance with the Contract Documents regarding bar grade, size, spacing and configuration.

b. Bar dimensions and quantities will not be reviewed or checked.

c. Review of fabrication and placement drawings by the Engineer does not relieve the Contractor from responsibility for both the accuracy of the shop drawings and the correct placement of rebar in the field.

4. Do not fabricate or place rebar before the placement drawings have been reviewed and returned to the Contractor.

1.03 QUALITY ASSURANCE

A. Reference Standards:

1. American Concrete Institute (ACI):

a. ACI 315 – Details and Detailing of Concrete Reinforcement.

b. ACI 318 – Building Code Requirements for Structural Concrete.

c. ACI 301 – Specifications for Structural Concrete for Buildings.

2. American Society for Testing and Materials (ASTM):

a. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

b. ASTM A185 – Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

c. ASTM A615 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

d. ASTM A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.

3. American Welding Society (AWS) D1.4 – Structural Welding Code – Reinforcing Steel

4. Concrete Reinforcing Steel Institute (CRSI):

a. Manual of Standard Practice.

b. Recommended Practice for Placing Reinforcing Bars.

c. Recommended Practice for Placing Bar Supports, Specifications and Nomeclature.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Ship and store reinforcement bars of the same size and shape fastened in bundles with durable tags. Mark in a legible manner with waterproof markings showing the same designations as shown on the submitted placement drawings.

B. Store reinforcement off the ground, protect from moisture, and keep free from dirt, oil, and other injurious contaminants.

C. Protect reinforcement from rusting, deforming, kinking, foreign substances that will reduce bond, and other injury.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60.

B. Deformed Concrete Reinforcing Bars to be Field Bent or Welded: ASTM A706, Grade 60.

C. Welded Wire Fabric: Galvanized welded steel mesh conforming to ASTM A185, Grade 60. Furnish flat, not in roll.

D. Tie Wire: ASTM A82, No. 16 gauge or heavier, black or galvanized, soft or commercial grade steel tie wire.

E. Supports and Spacers: Metal accessories including spacers, chairs, ties and other devices necessary for proper placement, spacing, supporting and fastening reinforcement in place.

1. Conform to the CRSI “Manual of Standard Practice”.

2. Provide spacers, chairs, bolsters, and other devices to support and secure reinforcement in place.

3. Use concrete block supports for footing and slabs on grade.

4. Use stainless steel or plastic tip chairs for exposed finished concrete surfaces.

5. Plastic chairs shall be allowed for use in forms for pre-cast concrete segment construction.

2.02 SOURCE QUALITY CONTROL

A. Shop fabricate reinforcing steel to conform to the required shapes and dimensions, in accordance with CRSI standards. Field bending will not be permitted.

B. Cold bend reinforcing steel, and do not straighten or re-bend after the initial bending.

C. Bend bars around a revolving collar having a diameter not less than that recommended by the ACI 318. Fabricate hooks in conformance to ACI 318.

D. Do not damage in bending.

E. Do not use bars with kinks or improper bends.

F. Reinforcement reduced in section is not acceptable.

PART 3 - EXECUTION

3.01 PREPARATION

A. Before placing concrete, clean reinforcement of mortar, oil, grease, dirt, loose mill scale, loose rust, and any other coating of such character, including laitance that would reduce bonding to concrete. Reinforcing bars with a thin coating of rust resulting from short exposure to atmosphere will not be considered objectionable.

B. Remove concrete, curing compound, and other deleterious material from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placement.

C. Verify that items to be embedded in concrete are secured in place as required.

3.02 INSTALLATION OF REINFORCING STEEL

A. Firmly and securely hold reinforcing bars in position by wiring at intersections, and by using pre-cast concrete blocks or metal chairs, spacers, metal hangers, supporting wires, and other approved devices of sufficient strength to resist crushing under full load and to prevent displacement during concrete placing operations. Tie bar reinforcement with tie wire to prevent displacement during concrete placement.

B. Reinforcement bar support methods which leave marks or impressions on the finished concrete surface shall not be allowed.

C. Locate and place bar supports in accordance with CRSI and in sufficient number to prevent sagging of the rebar mat due to loads during construction.

D. Place reinforcing bars such that the minimum clear protective covering for reinforcement adjacent to concrete surfaces and minimum clear bar spacing is in accordance with the Drawings.

E. Do not place bars on layers of fresh concrete as the work progresses or adjust bars during the placing of concrete.

F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the tolerances specified herein, the resulting arrangement of bars shall be as approved by the Engineer.

3.03 SPLICING

A. Lap Splices:

1. Furnish full length of reinforcement to the extent practicable. Splice bars as shown on the reviewed placement drawings.

2. Lap Lengths: In accordance with ACI 318, Section 12.15.1 for a Class B splice.

3. Splice reinforcing bars as indicated by lapping and securely wiring together.

4. Indicate splice locations on placement drawings. Stagger splice locations with no more than 50% of the bars spliced at any section. Mechanical splices may be substituted for contact lap splices, subject to approval by the Engineer. If mechanical splices are approved, install in accordance with manufacturer's requirements.

a. Wall Reinforcing: Stagger splices for curtains of horizontal reinforcing a minimum of 3 feet with no more than 50% of the bars spliced in one location. Do not perform splicing in two opposing curtains of horizontal reinforcing in the same location. Lap splices of vertical reinforcing steel need not be staggered, unless otherwise indicated on the Drawings.

b. Beam Reinforcing: Stagger splices in horizontally and vertically adjacent longitudinal reinforcing a minimum of the longest adjacent splice length with no more than 50% of the bars spliced in the same location.

5. Do not field weld reinforcement in lieu of lapping.

6. Lap welded wire fabric in accordance with ACI 318.

B. Mechanical Coupler Installation: Use mechanical couplers in the locations indicated on the Drawings or in locations requested by the Contractor and approved by the Engineer.

3.04 REINFORCEMENT AROUND OPENINGS

A. Whenever the conduit, piping, sleeves, bolts, hangers, boxes or other embedded items interfere with the proper placement of reinforcing steel as detailed, submit proposed reinforcement adjustment to the Engineer for review.

B. Provide trim bars around openings as indicated on the Drawings.

3.05 INSPECTION

A. Notify the Engineer not less than 48 hours before reinforcing steel inspection is required and at least 24 hours prior to the Contractor's intent to place concrete. Correct any errors or discrepancies note by Engineer's inspection before concrete is placed.

B. Do not place concrete prior to the Engineer's final inspection and approval of reinforcement installation.

C. Where formwork will cover reinforcement and make reinforcement inaccessible for inspection, notify the Engineer to inspect reinforcement installation not less than 48 hours before formwork is erected.

END OF SECTION

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for cast-in-place concrete work.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals

2. Section 03 39 00– Concrete Curing

1.03 SYSTEM DESCRIPTION

A. Design Criteria

1. Design mixes in accordance with the provisions of ACI 318 to produce concrete having durability, strength, density, temperature, and other characteristics as specified herein.

2. Design mixes to provide adequate workability to be placed, consolidated, and finished under the expected job conditions and in the configurations indicated on the Drawings.

B. Performance Requirements

1. Water Tightness: It is intent of this Section to produce concrete of homogeneous structure, which when hardened will have the required strength, watertightness, and durability.

a. It is recognized that some surface hairline cracks and crazing will develop in the concrete surfaces due to normal expansion and contraction expected from specified concrete mixes.

b. Joints have been positioned in structures as indicated on the Drawings and curing methods have been specified for the purpose of reducing the number and size of these expected cracks,

2. Tolerances: Tolerances shall be in accordance with ACI 318 and CRSI, unless otherwise noted.

C. Options

1. Concrete may be produced at the Project Site, or may be supplied by a commercial ready-mix concrete plant and delivered to the site using appropriate ready mix trucks.

D. Materials Testing Requirements

1. Sample and perform, off-site or on-site, concrete quality control testing. Complete the tests listed below, undertaken in conformance to the ASTM standard identified.

a. Aggregate Properties:

1) Moisture Content: In accordance with ASTM C566.

2) Specific Gravity and Absorption: In accordance with ASTM C127 and C128.

3) Gradation: In accordance with ASTM C136.

4) Practice for Sampling: In accordance with ASTM D75.

5) Testing in accordance with ASTM C1260 and ASTM C295 is to be performed by a certified testing laboratory retained by the Contractor.

b. Cement Properties:

1) Chemical Properties: In accordance with ASTM C150, Tables 1 and 2.

2) Physical Properties: In accordance with ASTM C150, Table 3.

3) False Set: In accordance with ASTM C150, Table 4.

c. Pozzolan/Fly Ash Properties:

1) Chemical Properties: In accordance with ASTM C311 and ASTM C618.

2) Physical Properties: In accordance with ASTM C311 and ASTM C618.

3) Testing of the fly ash and/or the fly ash and concrete mixture is required to provide test data confirming that the fly ash in combination with the cement complies with the specified strength requirements and is compatible with the other concrete additives.

d. Silica Fume Properties: Conform to the requirements of ASTM C1240.

e. Admixture Properties:

1) Air Entraining Admixtures: In accordance with ASTM C260.

2) Chemical Admixtures: In accordance with ASTM C494, Table 1.

f. Concrete Properties:

1) Temperature: In accordance with ASTM C1064.

2) Slump: In accordance with ASTM C143.

3) Air Content: In accordance with ASTM C173 or C231.

4) Unit Weight: In accordance with ASTM C138.

5) Compressive Strength: In accordance with ASTM C31 and C39.

E. Concrete Mixes

1. After acceptance of proposed mix designs, prepare trial batches of the accepted mix. Determine slump and prepare a minimum of 8 test cylinders.

a. Test 4 cylinders at 7 days and 4 cylinders at 28 days. Average compressive strength of cylinders tested at 28 days shall be equal to or greater than the specified compressive strength.

2. Where the Concrete Supplier has test records of the proposed mix design, this data may be used in lieu of preparing and testing trail batches. Test data shall be

comprised of at least 30 tests that span a period of not less than 45 calendar days. Establish the average compressive strength and standard deviation for the test data as described in ACI 318, Part 3, Chapter 5.

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Product Data

1. Manufacturer's information, including specifications, handling and storage recommendations, and material safety data sheets for manufactured products used.

2. Manufacturer's specifications with application and installation instructions for all proprietary materials and items, including admixtures, bonding agents, joint systems, and curing compounds.

3. Aggregates:

a. Source for both fine and coarse aggregate.

b. Proof of aggregates' compatibility with cement to be used, including data proving that no issues related to alkali/aggregate reactivity exists.

c. Performance history of the proposed aggregate to be used.

4. Cement:

a. Brand of Portland cement, type of cement, and plant of manufacture.

b. Type of supplementary cementitious material to be used in allowable, limited proportion to substitute for Portland cement.

c. Mill test results for cement.

d. Mill test results for supplementary cementitious materials.

e. Shipping receipts showing source or other proof of source for all cement and supplemental cementitious material.

f. Certifications shall include chemical and physical properties, specific gravity and false set information.

5. Admixtures, if used:

a. Documentation that shows admixtures have a history of demonstrable satisfactory performance on major public projects under equivalent conditions.

C. Concrete Mix Design Data

1. Submit concrete mix designs and supporting data at least 20 days in advance of scheduled start of any concrete work.

2. Mix Design Testing: Performed by a certified laboratory.

3. For each mix proposed for use:

a. Concrete mix supplier, mix design number, and supply plant location.

1) Concrete mix constituents, including specific gravity or weight per cubic yard, and absolute volume of each constituent.

2) Gradation of fine and coarse aggregates.

b. Concrete mix characteristics, including:

1) 7, 28 and 56 day compressive strengths.

2) Water/cementitious material ratio.

3) Percent entrained air.

4) Density.

5) Slump.

6) Type and content of additives.

c. Documentation of Average Strength:

1) Furnish report for concrete produced by the same plant to be supplying the project.

2) Furnish reports no more than 12 months old.

d. Drying shrinkage test data as determined in accordance with ASTM C157.

e. For Field Experience Method, furnish a minimum of ten test reports encompassing a period of not less than 60 days.

f. For Trial Batch Method, furnish a minimum of three trial mixtures with a minimum of three different cementitious material contents and a minimum of three different water/cementitious material ratios. Furnish a plot of compressive strength versus water/cementitious materials ratio.

D. Quality Control Submittals

1. Concrete Supplier's certificate of conformance to ASTM C94 requirements for concrete production facilities.

2. Ready-mix delivery tickets for each truck in accordance with ASTM C94.

1.05 QUALITY ASSURANCE

A. Supplier Qualifications: A firm experienced in manufacturing ready-mixed concrete and that complies with ASTM C94 requirements for production facilities and equipment.

B. Source Limitations: Use the same brand of cement from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

PART 2 - PRODUCTS

2.01 READY MIXED CONCRETE

A. Ready Mixed Concrete: Prepared in accordance with ASTM C94, Option A.

2.02 MATERIALS

A. Portland Cement: ASTM C150, Type II.

1. At Contractor's option, Type HE cement may be used to accelerate development of compressive strength.

B. Aggregates

1. Fine Aggregates

a. Clean, durable natural sand or crushed stone conforming to ASTM C33.

b. Materials Passing 200 Sieve: Not more than 4 percent.

c. Limit deleterious substances in accordance with ASTM C33, Table 1 with coal and lignite not greater than 0.5 percent.

d. Sand equivalent shall not be less than 80 when tested according to ASTM D2419.

e. Meet the following requirements when tested in conformance with the specified ASTM test methods:

1) Soundness (ASTM C88): Weighted average loss after 5 cycles not to exceed 10 percent when tested with sodium sulfate.

2) Bulk Specific Gravity (ASTM C127): On the basis of saturated surface-dry aggregate not less than 2.60.

3) Absorption (ASTM C127): Not to exceed 3 percent.

4) Potential Reactivity (ASTM C289): Only use aggregates considered innocuous in the Work.

5) Potential Reactivity (ASTM C227): Only use aggregates considered innocuous in the Work.

2. Coarse Aggregate

a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).

b. Materials Passing 200 Sieve: 0.5 percent maximum.

c. Meet the following requirements when tested in conformance with the specified ASTM test methods:

1) Resistance to Abrasion (ASTM C131): For the loss for aggregate size range 3/4-inch to 3/16inch after 100 revolutions and 500 revolutions do not exceed 10 percent and 35 percent, respectively. Include within the test sample seven parts of Grading B and three parts of Grading C.

2) Resistance to Abrasion (ASTM C535): For the loss for aggregate size range 1-1/2-inches to 3/4-inch (Grading 3) after 200 revolutions and 1000 revolutions do not exceed 10 percent and 35 percent, respectively.

3) Soundness (ASTM C88): Weighted average loss after 5 cycles not to exceed 10 percent when tested with sodium sulfate.

4) Bulk Specific Gravity (ASTM C127): On the basis of saturated surface-dry aggregate not less than 2.60.

5) Absorption (ASTM C127): Not to exceed 3 percent.

6) Potential Reactivity (ASTM C289): Only use aggregates considered innocuous in the Work.

C. Admixtures:

1. Use: Admixtures may be included in the concrete mix designs to improve the workability of the concrete or enhance other aspects of concrete, provided the specified strengths and other characteristics of the concrete can be achieved and maintained.

2. Limitations: Do not use admixtures that contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

3. Admixtures:

a. Air-Entraining: Conform to requirements of ASTM C260.

b. Water-Reducing: Conform to requirements of ASTM C494, Type A or D.

c. Superplasticizers: ASTM C494, Type F or G.

d. Fly Ash: ASTM C618, Class C or F.

e. Color Pigments: Inert mineral or metal oxide pigments, natural or synthetic; resistant to lime and other alkalies.

D. Water: Use clean, potable water, free from impurities detrimental to concrete.

2.03 CONCRETE MIXES

A. Provide concrete consisting of the Types listed in the table below.

B. Provide concrete mixes with at least the minimum weight of cementitious materials per cubic yard specified herein, regardless of the fact that the strength specified may be obtained with lesser amounts of cement.

C. Concrete mixes shall conform to the following table:

Concrete Class and Location	Compressive Strength, psi	Max Water Content Ratio by Weight	Minimum Total Cementitious Material Content (lb/yd^3)	Silica Fume, Percent by weight of Total Cementitious Material	Maximum Size of Coarse Aggregates, inches	Slump Range Per ASTM C143, inches
Type A	4000	0.48	590	5-10	1	4“±1“
Type B	3000	0.55	560	Not Specified	3/4	5“±1“
Type C	2500	0.62	425	5-10	1-1/2 (pavement) 3/4 (all other applications)	5“±1“

Notes:

1. The Contractor has the option of providing concrete with Pozzolan as a cement replacement to the limits prescribed on the table. Pozzolan may comprise up to 15% of the minimum specified cement content and may be increased to a maximum of 30% of the specified cement content, provided the mix design contains at least 80% of the minimum specified cement content.
2. Use Type A concrete for all structures. Use Type B concrete for sidewalks, curbs, fence post foundations, and sign foundations. Use Type C concrete for thrust blocks, reinforced concrete pavement and fill concrete where indicated on the Drawings.

D. Maximum Drying Shrinkage: 0.05% for Type A Concrete.

E. Air content: 4±1.5 percent entrained air as measured by the Pressure Method per ASTM C231, at the time when the mix is discharged from the truck.

F. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Non-agitating equipment is not allowed.

PART 3 - EXECUTION

3.01 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Before Placing Concrete

1. Check reinforcing steel for proper placement and correct discrepancies.

2. Remove excessive rust, mill scale, dirt, oil and other material from rebar that may adversely affect bonding to concrete.

3. Remove water from excavation and debris and foreign material from forms.

C. Before depositing new concrete on existing concrete, clean surface using sandblast or other mechanical means to obtain a 1/4 inch rough profile, and apply epoxy bonding agent in accordance with the manufacturer's instructions.

D. Concrete Placement

1. Place within 1-1/2 hours after adding cement to mix.

2. Place concrete without segregation or loss of ingredients and without splashing forms or steel above.

3. Place concrete continuously in horizontal layers with fresh concrete deposited over previous placements that are still plastic. Deposit concrete in layers not exceeding 18 inches in thickness.

4. Do not place concrete that has surface-dried, partially hardened, or contains foreign material.

5. Do not drop concrete vertically greater than five feet except where chutes or other suitable equipment is provided to prevent segregation.

6. Placement Using Tremie Methods: Place concrete in or under water in conformance to the recommendations of ACI 304R.

7. If truck is being sampled, place no more than 1/2 cubic yard until tests demonstrate concrete conforms to temperature, air content, and slump requirements.

8. Deposit concrete in or close to its final position as to prevent segregation due to rehandling or flowing.

9. Integrate fresh concrete with that already placed; no re-tempering of concrete already placed will be allowed. After concrete has taken an initial set, protect forms from jarring and do not place any strain on ends of projecting reinforcement.

10. Remove splash or accumulation of hardened or partially hardened concrete. Protect contact faces of forms for exposed concrete from splash during placing of adjacent concrete.

11. Discontinue casting when depositing is interrupted longer than 45 minutes. In this event, cut back concrete and provide construction joints; clean forms and reinforcing as necessary to receive concrete at later time.

E. Hot Weather

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 305R.

2. Maintain concrete temperature below 80 degrees F at time of placement, or furnish test data or provide other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking due to heat of hydration. Ingredients may be cooled before mixing to maintain fresh concrete temperatures at 80 degrees F or less.

3. Make provisions for windbreaks, shading, fog spraying, sprinkling, ice, or wet cover, or other means to provide concrete with temperature specified.

4. Maximum allowable temperature differential between reinforcing steel and concrete: Not greater than 20 degrees F at the time of concrete placement.

3.02 CONSOLIDATION

A. Consolidate concrete by mechanical vibration in conformance with the recommendations of ACI 309R.Vibrate concrete as follows:

1. Apply vibrator at uniform spacing over the entire area of the placement. Space the distance between insertions such that the influence zones of each insertion overlap.

2. Thoroughly work concrete around reinforcement and embedded items and into corners of forms to eliminate air and rock pockets. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.

3. Vibrate until concrete becomes uniformly plastic.

4. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

3.03 CONSTRUCTION JOINTS

A. Locate as indicated on the Drawings or as proposed by Contractor and approved by the Engineer.

B. Maximum Spacing Between Construction Joints: 40 feet.

C. Clean joints, exposed reinforcement, and forms by sandblasting or water blasting prior to placing concrete.

3.04 PROTECTION AND CURING

A. Comply with Section 03 39 00.

B. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.

C. Keep concrete slabs continuously wet for a 7 day period. Intermittent wetting is not acceptable.

D. Use curing compound only where approved by Engineer. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is complete.

1. Do not use curing compound on concrete surfaces that will be painted.

3.05 CONCRETE REPAIR

A. Contact Engineer prior to performing concrete repair.

B. Remove and replace concrete damaged by freezing.

C. Repair defective areas by removing unconsolidated areas, rock pockets, and other defective areas, then patch and repair using same material as the concrete with no coarse aggregate. Match color and texture of the repair to the surrounding area.

3.06 FIELD QUALITY CONTROL

A. Concrete Samples

1. Provide concrete for making composite samples for testing slump, air content, and for making cylinders for determination of compressive strength.

2. Prepare samples in accordance with ASTM C172. Select trucks or batches of concrete on a random basis.

3. Samples may be obtained at the discharge chute of the truck or at the point of discharge into forms.

B. Sampling Frequency: One composite sample for each 100 cubic yards of structural concrete, or fraction thereof, of each concrete mixture placed in any one day.

C. Evaluation will be in accordance with ACI 301, Chapter 17 and Specifications.

D. Slump tests and concrete cylinders will be made by the Owner at the time concrete is placed in the field. Owner will handle cured test cylinders, transport to the testing laboratory and pay testing costs.

E. Concrete Testing

1. Obtain four test cylinders.

2. Test cylinders will be tested for compressive strength tests in conformance with ASTM C39.

3. Test cylinders will be tested at 7 days, 15 days, 28 days and 56 days.

F. Enforcement of Compressive Strength Requirements

1. Compressive strength of concrete will be considered acceptable if the following conditions are satisfied:

a. Averages of all sets of 3 consecutive strength test results are greater or equal to the specified compressive strength.

b. No individual strength test (average of 2 cylinders) falls below specified compressive strength by more than 500 pounds per square inch.

2. Whenever one, or both, of the conditions stated above is not satisfied, provide additional curing of affected portion of structure, then obtain test cores from the affected area.

   a. Obtain 3 test cores in accordance with ASTM C42 and ACI 318.

   b. Concrete will be considered acceptable if the average compressive strength of the 3 test cores is equal to at least 90 percent of the specified 28-day compressive strength and no single core is less than 80 percent of the specified 28-day compressive strength.

   c. Concrete will be designated as defective when the specified conditions are not achieved.

   d. Fill core holes with concrete.

3. Engineer may require the Contractor to strengthen defective concrete by means of additional concrete, additional reinforcing steel, or replacement of defective concrete, all of the Contractor's expense.

END OF SECTION

SECTION 03 39 00

CONCRETE CURING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for curing of concrete.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01 33 00 – Submittals

1.03 SUBMITTALS

A. Comply with Section 01 33 00.

B. Product Data: Provide manufacturers' data for the following products:

1. Evaporation retardant.

2. Curing compound.

C. Description of proposed curing methods.

1.04 QUALITY ASSURANCE

A. Reference Standards:

1. American Society for Testing and Materials (ASTM):

a. C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing concrete.

b. C131 – Standard Specification for Liquid Membrane-Forming Compounds having Special Properties for Curing and Sealing Concrete.

c. C171 – Standard Specification for Sheet Materials for Curing Concrete

PART 2 - PRODUCTS

2.01 MATERIALS

A. Curing Compound

1. Water-based, high solids content non-yellowing curing compound meeting requirements of ASTM C309 and C131.

2. Moisture Loss: 0.40 kg/square m/72 hours maximum.

3. Capable of meeting moisture retention at manufacturer's specified application rate.

4. Manufacturers and Products:

a. Chemrex, Inc., Shakopee, MN; Masterkure.

b. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.

c. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.

d. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.

e. Dayton Superior; Safe Cure and Seal 30 percent.

B. Curing Blankets: Non-staining blankets, consisting of burlap or cotton mats, rugs or carpets.

C. Curing Paper: Non-staining waterproof paper conforming to ASTM C171.

D. Evaporation Retardant

1. Optional: Fluorescent color tint that disappears completely upon drying.

2. Manufacturers and Products:

a. Master Builders Co., Cleveland, OH; CONFILM.

b. Euclid Chemical Co., Cleveland, OH; Eucobar.

E. Water: Clean and potable, containing less than 500 ppm of chlorides.

PART 3 - EXECUTION

3.01 CONCRETE CURING

A. General

1. Minimum Concrete Cure Time: 7 days.

2. Cure concrete that is to receive coatings, painting, cementitious material, or other similar finishes, or where solvent-based coatings are not permitted, by using either water curing procedures or plastic membrane curing procedures.

B. Curing Concrete Walls

1. Cure concrete walls using one of the following methods:

a. Method 1: Leave concrete forms in place and keep entire surfaces of forms and concrete wet for 7 days.

b. Method 2: Apply curing compound, where allowed, immediately after removal of forms.

c. Method 3: Continuously sprinkle with water 100 percent of exposed surfaces for seven days starting immediately after removal of forms.

2. When forms are left in place, do not loosen form ties during the curing period.

C. Curing Concrete Slabs

1. Cure concrete slabs using one of the following methods:

a. Method 1: Keep concrete wet by water ponding or continuous water sprinkling for 7 days.

b. Method 2: Apply curing compound, where allowed, immediately after concrete finishing is completed.

c. Cover with burlap or cotton mats and keep continuously wet for 7 days.

d. Method 3: Cover with plastic membrane, seal joints and edges with sand and keep concrete moist under the plastic membrane for 7 days.

e. Other agreed upon method that will keep moisture present and uniform at all times on surface of slabs.

2. Where water curing for slabs during cold weather is not possible, utilize a curing compound. Apply at manufacturer's recommended coverage per gallon.

3. Protect slabs during cold weather with plastic sheets or other material inside required heated enclosure if foot traffic is permitted on slabs.

3.02 CURING COMPOUND APPLICATION

A. Apply curing compound to concrete surface immediately after removal of forms or completion of finishing work.

B. Maintain curing compound on the concrete surface for 7 days.

C. After curing period is complete, remove curing compound within construction joints by sandblasting prior to subsequent placement of concrete.

D. Apply compound using sprayer. Apply compounds in at least 2 coats with the second coat applied in a direction that is 90 degrees to the direction that the first coat was applied.

E. Apply coating in sufficient quantity that the compound can be removed by scraping after 24 hours and so that the concrete is uniform in appearance.

F. When the curing period is complete, remove applied curing compound on concrete surfaces exposed to view by sandblasting so that the finished concrete has a natural color and consistent and uniform appearance.

3.03 EVAPORATION RETARDANT APPLICATIONS

A. When environmental conditions may result in rapid evaporation of moisture from the surface of freshly placed concrete, spray evaporation retardant onto surface of concrete immediately after screeding.

1. Environmental conditions that may result in rapid loss of moisture include:

a. Low humidity.

b. Windy conditions.

c. High temperature.

B. Reapply retardant as needed to ensure a continuous moist surface until final finishing is completed.

END OF SECTION

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SECTION 03 60 00

GROUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Grout for uses other than masonry construction, including:

1. Dry pack grout
2. Cement grout
3. Nonshrink grout, non-metallic
4. Nonshrink grout, metallic
5. Pressure grout
6. Epoxy grout
7. Polymer concrete

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 03 30 00– Cast-in-Place Concrete

1.03 SUBMITTALS

A. Conform to Section 01 33 00.

B. Product Data

1. Manufacturer’s product data of all materials proposed for use in the Work.
2. Manufacturer’s literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the Work

C. Laboratory Test Reports

1. Test reports on previously tested materials shall be accompanied by the manufacturer's statement that the previously tested material is the same type, quality, manufacture, and make as that proposed for use in this project.
2. Test reports are required for the following:
   a. Cement
   b. Aggregates
   c. Bonding compounds
   d. Admixtures

D. Certifications that all grout used on the project are free of chlorides or other chemicals that may cause corrosion.

1.04 QUALITY ASSURANCE

A. Field tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Owner to insure compliance with the Contract Documents.

2. The test specimens will be obtained, tested, and paid for by the Owner except the Contractor will be charged the cost of any additional tests on work which does not meet the Specifications.

3. Compression tests for grout and non-shrink grout:

   a. Per ASTM C109.

   b. Obtain three samples.

   c. At a minimum test at 7 and 28 days.

4. Compression test for epoxy grout:

   a. Per ASTM C579 Method B.

   b. Obtain three samples.

   c. At a minimum test at 7 days.

5. Remove and replace all grout that does not meet the Specification requirements at no additional cost to the Owner.

B. Pre-installation demonstration and training.

1. Coordinate and pay for demonstration and training sessions by the grout manufacture where pre-installation demonstration and training is indicated in the grout schedule before grout installation is started.

2. Conduct training with the Contractor's employees who will be doing the grout work in attendance.

3. Include demonstration and training on mixing, preparation, application and curing each type of grout to be used.

4. Obtain test specimens of each grout type and conduct compression testing at 1, 3, and 28 days for each type of grout to be used. Demonstration and training testing to be paid for by the Contractor.

5. Demonstration and training sessions may be conducted on actual project placements such as baseplates and tie holes.

6. Mix sufficient amount of each grout type to complete the equivalent of one 12-inc by 12-inch baseplate and a set of 6 test specimens.

7. Transport test cubes to an independent test laboratory, obtain test reports, and submit test results to the Owner.

PART 2 - PRODUCTS

2.01 GENERAL

A. Use grouts indicated in the grout schedule whether called for on Drawings or not.

2.02 CEMENT GROUT

A. Portland cement ASTM C150 Type II or Type V

B. Low alkali, containing less than 0.60 percent alkalies.

C. Aggregate

1. Nonreactive and washed before use.

2. Fine Aggregate

a. Hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine and shall conform to ASTM C33 as modified herein.

b. Gradation (ASTM C136): 100 percent by weight will pass a standard No. 8 mesh sleeve and no less than 45 percent by weight will pass a standard No. 40 mesh sieve.

c. Tolerance: The average of three consecutive tests fall within the limits listed below:

US standard sieve size	Permissible variation in individual tests, percent
30 or coarser	2.0
50 or finer	0.5

3. Meet the requirements of the following specifications:

Test	Test Method	Requirements
Organic Impurities	ASTM C40	Color lighter than standard
Amount of Material Passing No. 200 Sieve	ASTM C117	3% maximum by weight
Soundness	ASTM C88	10% maximum loss with sodium sulfate
Sand Equivalent	ASTM D2419	Minimum 80

4. Admixtures

a. General

1) Compatible with the grout.

2) Do not use calcium chloride or admixtures containing calcium chloride.

3) Follow the manufacturer's recommendations for use.

4) Add separately to the grout mix.

b. Water Reducing Retarder

1) ASTM C494 Type D.

2) Manufactured by:

a) Master Builders MasterSet R 300,

b) Sika Corporation Plastiment,

c) Or equal.

c. Lubricant for Cement Pressure Grouting

1) Manufactured by:

a) Intrusion Prepakt Intrusion Aid,

b) Sika Intraplast N,

c) Or equal.

5. Water

a. Free from oil and deleterious amounts of acids, alkalies, and organic materials;

b. Do not use water containing more than 500 mg/1 of chlorides as Cl, nor more than 800 mg/1 of sulfates as SO_4;

c. Do not use water containing impurities that may cause a change of more than 25 percent in the setting time of the cement nor a reduction of more than five percent in the compressive strength of the grout at 14 days when compared with the result obtained with distilled water.

d. Do not use water for curing that discolors the grout.

D. Drypack Grout

1. A mixture of approximately one part cement, 1-1/2 to 2 parts sand, water reducing retarder, and sufficient water to make a stiff workable mix.

2. Consistency: Plastic and moldable but does not flow.

E. Cement Grout

1. Mixture of one part cement, two parts sand, proportioned by volume, admixtures for pressure grouting, and sufficient water to form workable mix.

2. Maximum slump: 4 inches.

2.03 PREPACKAGED GROUT

A. Non-shrink Grout

1. Cementitious non-shrink, non-metallic grout

2. Conform to ASTM C827 and C1107.

3. Manufactured by:

a. Sika Corporation, SikaGrout 212

b. Five Star Products, Inc. Five Star Grout

c. Chemrex Inc. Masterflow 928

d. Euclid Chemical Co. High-Flow Grout

e. Or equal.

B. Epoxy grout bonding/grouting adhesive

1. Multi-purpose, two-component, 100% solids, moisture-tolerant, structural adhesive.

2. Conform to ASTM C881, Types I, II and V, Grade-2.

3. Manufactured by:

a. Sika Corporation, Sikadur 32, Hi-Mod

b. Chemrex Inc. MasterFlow 649

c. Or equal.

C. Epoxy grout paste adhesive

1. High modulus, two-component, moisture insensitive, 100 percent solids, thermo-setting modified polyamid epoxy compound.

2. Paste form consistency capable of not sagging in horizontal or overhead anchoring configurations.

3. Conform to ASTM C881 Type 1, Grade 3

4. Heat deflection temperature: In excess of 130 degrees F.

5. Manufactured by:

a. Chemrex Inc. Concresive Paste LPL

b. Sika Corporation Sikadur Hi-Mod Series

c. Adhesive Technology Corporation Ultrabond 1350

d. Or equal,

D. Epoxy grout for pressure grouting

1. Two-component, 100% solids, moisture-tolerant, epoxy adhesive. Low-viscosity, high-strength adhesive formulated specifically for injection grouting.

2. Consistency as necessary to achieve complete penetration in hairline cracks and larger.

3. Conform to ASTM C881 Type 1 and 2, Grade 1.

4. Manufactured by:

a. Sika Corporation Sikadur 52

b. Chemrex Inc. Concresive LV1

c. Adhesive Technology Corporation SLV 300 series

d. Or equal.

E. Polymer concrete grout

1. Liquid binder and dry aggregate mixed together to make a mortar or grout of a consistency as necessary for the application.

2. Liquid binder: Chemical and oil resistant, stress relieved, low modulus, moisture insensitive, two-component epoxy-resin compound.

3. Consistency similar to lightweight oil for proper mixing with aggregate.

4. Conform to ASTM C881 Type 3 Grade 1,

5. Aggregate:

   a. Size and consistency compatible with recommendations of manufacturer of liquid binder for intended application.

   b. Keep aggregate oven dry in sealed packages until time of mixing.

6. Manufactured by:

   a. Sika Corporation Sikadur Lo-Mod series

   b. Adhesive Engineering Concresive 1470

   c. Adhesive Technology Corporation 400 series

   d. Or equal.

2.04 PRESSURE GROUTING EQUIPMENT

A. Mixer and holdover agitator tanks

B. Designed to place grout at pressures up to 50 psi.

C. Provide gages to indicate pressure grout pressure during application.

D. Provide mixer with a meter capable of indicating to one-tenth of a cubic foot the volume of grout used.

PART 3 - EXECUTION

3.01 GENERAL

A. Conduct mixing, surface preparation, handling, placing, consolidation, and curing for prepackaged grouts according to the instructions and recommendations of the grout manufacturer.

B. Mix grouts in a mortar mixer.

C. Bonding compound for use with grout is specified in Section 03 30 00.

D. Provide primer, if required, for polymer concrete, per manufacturer's recommendation.

3.02 DRYPACK GROUT

A. Roughen surfaces to be built up with drypack grout by brushing

B. Clean, and coat surface with bonding compound in conformance to Section 03 30 00 before the application of the grout.

C. Apply drypack grout immediately following the application of the bonding compound in layers to the required thickness.

D. Finish the surface smooth.

E. Where construction joints are necessary, slope face of construction joints and clean and wet the existing grout before application is resumed.

F. Cure drypack grout in accordance with Section 03 30 00.

G. Do not place drypack grout during freezing weather unless adequate protection is provided.

3.03 CEMENT GROUT

A. Except for the specialized equipment for pressure grouting, mixing and placing apparatus use equipment similar to that normally used for cast-in-place concrete.

B. Mix grout for a period of at least 1 minute.

3.04 NONSHRINK GROUT

A. Place in accordance with manufacturer's instructions.

3.05 EPOXY GROUT

A. Prime surface to be grouted in accordance with the grout manufacturer's instructions.

3.06 PRESSURE GROUTING

A. Prior to grouting, Wash clean surfaces and holes to be grouted, prior to grouting.

B. Washing is not required for grouting soil voids outside pipe cylinders or casing pipes.

C. Once commenced, continue grouting to completion without stoppage.

D. In case of breakdown of equipment, wash out the grouting system sufficiently to ensure fresh grout and adequate bond and penetration will occur upon restarting the grouting operation.

E. Maintain grout pressure until grout has set.

3.07 GROUT SCHEDULE

A. Use grout type indicated in the table below unless otherwise indicated.

Grout	Application
Drypack Cement Grout	Built-up surfaces, setting miscellaneous metal items and minor repairs.
Cement Grout	Filling nonbearing portions of equipment pads and pressure grouting.
Non-shrink Grout	Bearing surfaces of machinery and equipment bases, column base plates, and bearing plates, and setting handrail, guardrail, or fence posts in pipe sleeves.
Epoxy Grout	Reinforcing steel set in grout, repairing cracks in concrete, concrete repair.
Pressure Grout	Repairing cracks in concrete.
Polymer Cement Grout	Repair of concrete floors, patching.

END OF SECTION

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SECTION 05 50 01

ANCHOR BOLTS AND ANCHORING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Anchor bolts, concrete anchors, adhesive anchors, and other anchoring devices.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section

1. Section 01 33 00 – Submittals

1.03 SUBMITTALS

A. Comply with Section 01 33 00.

B. Product Data: Manufacturer's data for nuts, bolts, concrete anchors, chemical anchors and other fasteners.

C. Catalog data and ICC reports for each type of anchor bolt.

1.04 QUALITY ASSURANCE

A. For applications that require special inspection in accordance with building codes, coordinate the progress of the Work with the required inspection activities.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified or indicated on the Drawings, materials of construction for anchoring devices shall conform to the following:

1. Anchor bolts and other anchoring devices, nuts and washers installed indoors: Type 304 stainless steel.

2. Anchor bolts and other anchoring devices, nuts and washers installed outdoors or in locations exposed to wastewater: Type 316 stainless steel.

a. Locations exposed to wastewater includes:

1) Below tops of walls of water-containing structures.

2) Underside of roof, slab or walkways of enclosed water-containing structures.

3) Dry side of walls on water-containing structures.

2.02 CAST-IN-PLACE ANCHOR BOLTS

A. Locations for use of cast-in-place anchor bolts:

1. In locations indicated on the Drawings.

2. To anchor engine-driven equipment and equipment with motors 3 horsepower and larger.

B. Cast-in-Place Anchor Bolts

1. Material: Stainless steel conforming to ASTM A320.

2. Minimum Length of Bolt: As indicated on the Drawings. When not indicated, provide bolt length such that the length of the embedded anchor is at least 10 bolt diameters.

3. Minimum length of 90-degree hook: 4 bolt diameters.

2.03 CONCRETE ANCHORS

A. Concrete Anchors: Drilled in place wedge-type anchors with threaded stud body, stainless steel expansion clip, nut and washer.

B. Materials: Type 304 or Type 316 stainless steel, depending upon installed location.

C. Code Compliance: Test in accordance with, and comply with requirements of, ASTM E488 and ICC-ES AC193.

D. Manufacturers: One of the following or equal:

1. Hilti Kwik Bolt 3.

2. ITW Redhead, Trubolt Wedge Anchor.

3. Dewalt Fasteners, Power-Stud SD4 or SD6.

4. Simpson Strong Tie, Strong-Bolt 2 Wedge Anchors.

2.04 STUDS

A. Material: Conforming to ASTM A108 with 50,000 pounds per square inch minimum yield strength, and 60,000 pounds per square inch minimum tensile strength.

B. Manufacturers: One of the following or equal:

1. Nelson Stud Welding Company, S3L Shear Connectors or H4L Concrete Anchors.

2. Stud Welding Products, Headed Concrete Anchors and Shear Connectors or Concrete Anchors.

2.05 ADHESIVE ANCHORS

A. Applications: Use for bonding threaded rods and concrete reinforcing bars to hardened concrete and grouted cement masonry. Do not use in overhead applications, in chlorine gas environments, or where anchor may be exposed to machine oil or diesel oil.

B. Code Compliance: Test in accordance with, and comply with requirements of, ASTM E488 and ICC-ES AC58.

C. Materials

1. Epoxy Adhesive: Two component, injectable epoxy adhesive.

2. Concrete Reinforcing Bars: Grade 60.

3. Threaded Rods: Type 304 stainless steel all-thread rod conforming to ASTM F593.

D. Manufacturers: One of the following or equal:

1. Hilti HVA Adhesive Anchor System.

2. ITW Redhead G6+ Adhesive Anchoring System.

3. Dewalt Fasteners PE1000+ Epoxy Anchoring System.

4. Simpson Strong Tie, SET-XP Epoxy Adhesive.

PART 3 - EXECUTION

3.01 GENERAL ANCHORING REQUIREMENTS

A. Use equipment shop drawings, anchorage layout drawings, and anchor bolt layout templates to accurately position anchor bolts.

B. Install anchor bolts, concrete anchors and other anchoring devices with at least 2 threads projecting beyond the nut, but no more than 1/2-inch projecting beyond the nut.

C. Prior to installing nuts, coat threads of stainless steel bolts with material to prevent galling of threads.

1. Manufacturers: One of the following or equal:

a. Never Seez Compound Corporation, Never-Seez.

b. Oil Research, Inc., WLR No. 111.

D. Tighten nuts on anchor bolts, concrete anchors and other anchoring devices to the "snug-tight" condition, defined as tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary wrench.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Do not use expansion type concrete anchors or adhesive anchors as substitution for cast-in-place anchor bolts.

B. Accurately place anchor bolts to be embedded in concrete within the formwork and perpendicular to surface from which they will project. Secure in correct position while concrete is placed.

C. Do not allow anchor bolts to touch reinforcing steel. Where anchor bolts are within 1/4 inch of reinforcing steel, isolate with a minimum of 4 wraps of 10 mil polyvinyl chloride tape in area adjacent to reinforcing steel.

D. In anchoring machinery bases subject to heavy vibration, use 2 nuts, with 1 serving as a locknut.

E. Where bolts are indicated on the Drawings for future use, first coat thoroughly with non-oxidizing wax, then turn nuts down full depth of thread and neatly wrap exposed thread with waterproof polyvinyl tape.

F. Where indicated on the Drawings, set anchor bolts in metal sleeves having inside diameter approximately 2 inches greater than the bolt diameter and a minimum of 10 bolt diameters deep. Fill sleeves with grout when equipment is grouted in place.

3.03 CONCRETE ANCHORS AND ADHESIVE ANCHORS

A. Cast-in-place anchor bolts may be used in place of concrete anchors and adhesive anchors at Contractor’s option.

B. Installation

1. Drill holes using concrete drill bits and impact type drill motors. Hole diameter shall be in accordance with the manufacturer's recommendations.

2. Clean drilled hole using compressed air to dislodge and remove drilling dust.

3. Accurately locate concrete anchors and set anchors with axis perpendicular to surfaces from which they will project.

4. Do not disturb adhesive anchors until cure time has elapsed.

5. Unless otherwise indicated on the Drawings or as required by structural calculations prepared by the equipment supplier, comply with minimum embedment lengths identified in the following table.

Minimum Embedment Lengths for Concrete and Adhesive Anchors

Diameter of Anchor or Bar, inches	Embedment Length for Concrete Anchors, inches	Embedment Length for Adhesive Anchors or Reinforcing Bars
1/4	1-3/4	As indicated on the Drawings
3/8	1-7/8	
1/2	2-1/4	
5/8	2-3/4	
3/4	3-1/4	
(1) Provide longer embedment where otherwise indicated		

END OF SECTION

SECTION 05 55 05

MISCELLANEOUS METALWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Miscellaneous metalwork, which consists of custom fabricated metalwork.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 03 30 00 – Cast-in-Place Concrete

1.03 QUALITY ASSURANCE

A. General

1. Shop and field welding shall conform to the requirements of the AISC Steel Construction Manual, 15th Edition.
2. The use of salvaged, reprocessed or scrap materials will not be permitted.
3. Perform welding of structural metals with welders who have current American Welding Society (AWS) certificate for the type of welding to be performed.
4. Owner may use gamma ray, magnetic particle, dye penetrant or other aids to visually inspect or examine any weld.
5. Contractor shall bear costs of retests on defective welds.
6. Contractor shall also bear costs in connection with qualifying welders.

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Include the following items:

1. Manufacturer's catalog data confirming capacity and removal efficiency.
2. Shop drawings of members to be fabricated.
3. Parts list with materials of construction.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping: Package in a manner that will protect painted surfaces, galvanized surfaces and surfaces with fusion bonded epoxy.

B. Store metalwork off the ground, protect from moisture, keep free from dirt, oil and other injurious contaminants.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Nonstructural steel bars, angles, clips, and similar items: ASTM A36 or ASTM A283.

B. Iron castings: ASTM A48.

C. Structural steel tubing: ASTM A500, Grade B.

D. Steel bolts (except flanges and anchor bolts): ASTM A307, Grade A.

E. Stainless steel: ASTM A320, Type 304.

F. Aluminum cover plate: 6061-T6, ASTM B632.

2.02 FABRICATION

A. General

1. Unless otherwise specified punch holes 1/16-inch larger than the nominal size of the bolts.

2. If needed because of the thickness of the metal, subpunch and ream, or drill holes.

3. Perform fabrication including cutting, drilling, punching, threading and tapping required for miscellaneous metal or adjacent work prior to hot-dip galvanizing.

B. Seat Angles, Supports and Brackets

1. If seat angles pass over slide gate guides, weld to the guides.

2. If seat angles for grating, supports for floor plates, clips for precast panels and brackets for piping are specified as steel, hot-dip galvanized after fabrication.

C. Power Driven Pins

1. Power driven pins may be used in interior locations of nonprocess areas.

2. Material: heat-treated steel alloy per AISI 1062 or 4063 and zinc-plated.

3. Provide pins with capped or threaded heads capable of transmitting the loads the shanks are required to support.

4. If pins are connected to steel, provide with longitudinal serrations around the circumference of the shank.

5. Provide complete information describing pin capacities and connections to the Construction Manager.

6. Obtain approval of the Construction Manager prior to the use of pins at all locations.

D. Iron Castings

1. Provide where specified on the drawings.

2. If castings weigh less than 100 pounds, hot-dip galvanize after machining.

3. If castings weigh greater than 100 pounds, hot-dip galvanize where specified.

E. Other Miscellaneous Metalwork

1. Provide other miscellaneous metalwork including embedded and non-embedded steel metalwork, hangers and inserts as specified on the drawings.

2. Where indicated hot-dip galvanize steel material after fabrication in accordance with ASTM A123.

2.03 PERFORMANCE REQUIREMENTS

A. Structural Design:

1. Standard Weight Design Requirements: Design vault door with 1/4-inch aluminum plate, reinforced to withstand a live load of 300 pounds per square foot with a maximum deflection of 1/150 of the span.

2. Traffic Loading Design Requirements: Design vault door with 1/4-inch aluminum diamond pattern plate, reinforced to withstand an H-20 highway load with a maximum deflection of 1/150 of the span.

B. Operation: Smooth and easy opening and closing with controlled operation throughout the entire arc of opening and closing, regardless of ambient temperature. Provide lifting mechanism that retards downward motion of the cover when closing to prevent quick closing and slamming.

2.04 ACCESS HATCHES

A. Sizes and Design Loading Requirements: As indicated on the Drawings and specified herein. Sizes indicated reflect the clear opening required for each vault door.

B. Access Hatch Door

1. Double leaf or single leaf as indicated on the Vault Door Schedule.

2. Provide each leaf with a minimum of two compression spring lifting mechanisms designed to prevent the entry of dirt and foreign matter into compression spring housing.

3. Provide a recessed locking mechanism and flush lift handles.

4. Leafs: Diamond pattern, milled aluminum, 1/4-inch thickness, ASTM B221, Alloy 5086. Reinforce as necessary to comply with design loading requirements.

5. Leaf Gaskets: EPDM or neoprene gasket, mechanically attached to the vault door frame.

6. Type 316 stainless steel hardware throughout.

C. Hatch Hinges

1. Heavy forged aluminum with 1/4-inch diameter stainless steel hinge pins provided, designed to pivot so the cover does not protrude into the channel frame.

2. Specifically designed for horizontal installation.

3. Through bolted to the covers with tamperproof Type 316 stainless steel lock bolts and through bolted to the frame with Type 316 stainless steel bolts and locknuts.

D. Lifting Mechanisms:

1. Compression spring-type mechanism within a telescoping tube.

2. Provide automatic hold-open arms with release handles.

3. Attach lower tube of lifting mechanism to a flanged support shoe fastened to a formed 1/4" gusset support plate.

E. Locking Mechanisms:

1. Exterior: Provide removable turn/lift handle with spring loaded ball detent to open the cover. Protect latch release by a flush, gasketed, removable screw plug.

2. Interior: Provide Type 316 stainless steel snap lock with fixed handle mounted on the underside of the cover.

F. Frame: Aluminum channel frame, 1/4-inch thickness, ASTM B221 alloy 6063-T5, with a perimeter anchor flange with anchor tabs around the perimeter.

G. Provide a 1-1/2-inch drainage coupling, zinc plated and chromate sealed, in a corner of the channel frame.

H. Finish

1. Mill-finish with one of the following applied to the exterior of the frame:

a. Carboline "Bitumastic Super Service Black,"

b. Tnemec "46-499 Heavy Duty Black".

c. Valspar "High-Build Bitumastic Coating 35-T-10".

I. Manufacturers"

1. Bilco;

2. Thompson Fabrication Company;

3. Halliday Products, Inc.;

J. Fall Protection Grate

1. Underlying aluminum safety grates to allow inspection of the wet well while providing fall-through protection. Safety grates:

a. Designed to withstand a live load of 300 lb/ft2 with a maximum deflection of 1/150 of the span.

b. Fabricated from aluminum flat bars.

c. Openings between flat bars shall be not less than 4" x 4" to facilitate visual inspection.

d. Provided with a hinging system that will lock the grate in the 90° open position.

e. Provide an aluminum open arm with red vinyl grip.

f. Safety grates shall be safety orange color.

2.05 ALUMINUM FLOOR AND COVER PLATES (CHECKERED PLATE)

1. Provide hinged cover plates as detailed on Drawings and set flush with surrounding floor.
2. Limit single piece of floor and cover plate weight to 80 pounds maximum unless specifically detailed otherwise.
3. Provide lifting handles at two ends of the cover plates.
4. Provide a hole in the checkered plate to accommodate the stem of the slide gate. Coordinate with gate submittal.
5. Manufacturers, one of the following or equal:
   a. Alcoa C-102 aluminum tread plate.
   b. Reynolds diamond tread plate.

2.06 ACCESS HATCH AND CHECKERED PLATE SCHEDULE

Location	Qty	Opening Size	Design	Safety Grates	Style
Influent Pump Station: PMP-110-03, PMP-110-04, & PMP-110-05, See Drawing M111	3	48”x72”	Traffic Weight	Required	Double Leaf
Influent Pump Station: PMP-110-01, PMP-110-02 See Drawing M111	2	48”x30”	Traffic Weight	Required	Single Leaf
Influent Pump Station, SLG-110-00, See Drawing M111	1	48”x30”	Standard Weight	Required	Checkered Plate

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Fieldwork is not permitted on galvanized items.
2. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.
3. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings or isolators.
4. Metalwork to be embedded in concrete:
   a. Position accurately and hold in correct position while the concrete is placed; or, if specified, form recesses or blockouts in the concrete.
   b. Clean thoroughly all surfaces of metalwork in contact with or embedded in concrete.

c. If approved by the Construction Manager, recesses may be neatly cored in the concrete after it has attained its design strength and the metalwork grouted in place.

d. Construct embedments as specified in Section 03 30 00.

B. Seat Angles, Supports and Guides

1. Set seat angles for grating and supports for floor plates so that the floor and grating and floor plates are flush with the floor.

C. Power Driven Pins

1. Retain a craftsman who is certified by the manufacturer to set power driven pins.

2. Drive pins in one initial movement by an instantaneous force that has been selected to attain the required penetration.

3. Comply with the following:

Material penetrated by pin	Penetrated material's minimum thickness	Penetration of pin's shank in supporting material	Minimum space from center of pin's shank to edge of penetrated material	Minimum pin spacing
Concrete	16D	6D minimum	14D	20D
Steel	1/4 inch	Steel thickness plus 2D	4D	7D
Where D = pin shank diameter.				

4. When required by the Construction Manager, perform pullout tests to prove the effectiveness of the anchorage and the capacity of the pin.

3.02 ACCESS HATCH INSTALLATION

A. Install in accordance with the manufacturer's instructions.

B. Install vault door with frame set level and flush with the surrounding surface.

C. Coat the exterior surfaces of door frames with a bituminous paint.

D. Connect a 1-1/2-inch diameter copper drain pipe to the drainage coupling on the hatch frame and route the drain pipe to the nearest drain.

3.03 CLEANING

A. After installation, clean and touch damaged surfaces of shop-primed metals with the same material used for the shop coat.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Structural dimension lumber framing.

B. Exposed timber structural framing.

C. Rough opening framing for doors, windows, and roof openings.

D. Sheathing.

E. Roofing nailers.

F. Preservative treated wood materials.

G. Miscellaneous framing and sheathing.

H. Communications and electrical room mounting boards.

I. Concealed wood blocking, nailers, and supports.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in concrete.

B. Section 05 55 05 Miscellaneous Metals: Miscellaneous steel connectors and support angles for wood framing.

C. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.

D. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

D. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings 2018.

E. AWPA U1 - Use Category System: User Specification for Treated Wood 2021.

F. PS 1 - Structural Plywood 2009 (Revised 2019).

G. PS 2 - Performance Standard for Wood Structural Panels 2018.

H. PS 20 - American Softwood Lumber Standard 2021.

I. WWPA G-5 - Western Lumber Grading Rules 2021.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.

C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.

D. ABAA Field Quality Control Submittals: Submit third-party reports of testing and inspection required by ABAA QAP.

E. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

F. ABAA Manufacturer Qualification: Submit documentation of current evaluation of proposed manufacturer and materials.

G. ABAA Installer Qualification: Submit documentation of current contractor accreditation and current installer certification. Keep copies of all contractor accreditation and installer certification on site during and after installation. Present on-site documentation upon request.

1.05 QUALITY ASSURANCE

A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org/#sle:

1. Installer Qualification: Use accredited contractor, certified installers, evaluated materials, and third-party field quality control audit.

2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.

1. Species: Coast Region Douglas Fir, unless otherwise indicated.

2. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.

3. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

B. When possible, provide sustainably harvested woods.

C. When possible, provide wood harvested within a 500 mile (805 km) radius of the project site.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Grading Agency: Western Wood Products Association; WWPA G-5.

B. Sizes: Nominal sizes as indicated on drawings, S4S.

C. Moisture Content: 19% at the time of framing and less than 16% at the time of closing framing..

D. Stud Framing; Plates and Headers: (2 by 2 through 2 by 6 (50 by 50 mm through 50 by 150 mm)):

1. Species: Coast Region Douglas Fir.

2. Grade: No. 2 unless noted otherwise on the drawings.

E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:

1. Lumber: S4S, No. 2 or Standard Grade.

2.03 STRUCTURAL COMPOSITE LUMBER

A. Structural Composite Lumber: Factory fabricated beams, headers, columns, and wood I-Joists of sizes and types indicated on drawings; structural capacity as published by manufacturer.

1. Columns: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published E (modulus of elasticity): 1,800,000 psi (12,410 MPa), minimum.

2. Beams: Use laminated veneer lumber, laminated strand lumber, or parallel strand lumber with manufacturer's published E (modulus of elasticity): 1,800,000 psi (12,410 MPa), minimum.

3. Manufacturers:

a. Boise Cascade Company: www.bc.com/#sle.

b. Weyerhaeuser Company: www.weyerhaeuser.com/#sle.

c. Redbuilt; www.redbuilt.com..

d. Or equal.

e. Substitutions: See General Conditions 7.06, Substitutes.

2.04 CONSTRUCTION PANELS

A. Roof Sheathing: Any PS 2 type, rated Structural I Sheathing.

1. Bond Classification: Exterior.

2. Grade: Species Group 2 or better.

3. Span Rating: 40/20.

4. Performance Category: 5/8 PERF CAT.

5. Edges: Square if blocked or supported by clips or tongue and Groove

B. Wall Sheathing: Any PS 2 type.

1. Bond Classification: Exterior.

2. Grade: Group 2 or better..

3. Span Rating: 24 32/16.

4. Performance Category: 1/2 PERF CAT.

5. Edge Profile: Square edge.

C. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

D. Other Applications:

1. Non-Structural Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.

2. Non-Structural Plywood Exposed to View But Not Exposed to Weather: PS 1, A-D, or better.

3. Other Non-Structural Locations: PS 1, C-D Plugged or better.

2.05 ACCESSORIES

A. Fasteners and Anchors:

1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

3. Anchors: Epoxy adhesive with screen tube type for anchorage to hollow masonry; expansion shield and lag bolt type for anchorage to solid masonry or concrete; Bolt or ballistic fastener for anchorages to steel; or as indicated on the drawings.

B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.

1. For contact with preservative treated wood in exposed locations, provide minimum G185 (Z550) galvanizing complying with ASTM A653/A653M.

2. Provide connectors manufactured by Simpson Strong Tie.

3. Or equal

4. Substitutions: See General Conditions 7.06, Substitutes.

C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.

1. For contact with preservative treated wood in exposed locations, provide minimum G185 (Z550) galvanizing complying with ASTM A653/A653M.

2. Provide joist hangers manufactured by Simpson Strong Tie.

3. Or equal

4. Substitutions: See General Conditions 7.06, Substitutes.

D. Sill Gasket on Top of Foundation Wall: 1/4 inch (6 mm) thick, plate width, closed cell plastic foam from continuous rolls.

E. Sill Flashing: As specified in Section 07 62 00.

F. Water-Resistive Barrier: As specified in Section 07 25 00.

2.06 FACTORY WOOD TREATMENT

A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

B. Preservative Treatment:

PART 3 - EXECUTION

3.01 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches (100 mm) and seal.

B. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

C. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.

B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

C. Install structural members full length without splices.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.

E. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches (38 mm) of bearing at each end.

F. Construct double joist headers at roof openings; use metal joist hangers unless otherwise detailed.

G. Provide bridging at mid-span. Fit solid blocking at ends of members.

H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

E. Provide the following specific non-structural framing and blocking:

1. Cabinets and shelf supports.
2. Wall brackets.
3. Handrails.
4. Grab bars.
5. Towel and bath accessories.
6. Wall-mounted door stops.
7. Chalkboards and marker boards.

8. Wall paneling and trim.

9. Joints of rigid wall coverings that occur between studs.

3.05 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

3.06 INSTALLATION OF CONSTRUCTION PANELS

A. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.

1. At long edges provide solid edge blocking where joints occur between roof framing members where noted or detailed.

2. Nail panels to framing; staples are not permitted.

B. Wall Sheathing: Secure with long dimension parallel or perpendicular to wall studs, with ends over firm bearing, using nails, screws, or staples.

1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges and ends.

C. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.

1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.

2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.

3. Install adjacent boards without gaps.

3.07 TOLERANCES

A. Framing Members: 1/4 inch (6 mm) from true position, maximum.

B. Variation from Plane (Other than Floors): 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.08 CLEANING

A. Waste Disposal: Comply with the requirements of Section 01 57 19 – Environmental Controls.

1. Comply with applicable regulations.

2. Do not burn scrap on project site.

3. Do not burn scraps that have been pressure treated.

4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Board insulation at over roof deck, over roof sheathing, and exterior wall behind exterior wall finish.

B. Batt insulation in exterior wall construction.

C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Supporting construction for batt insulation.

B. Section 07 25 00 - Weather Barriers: Separate air barrier and vapor retarder materials.

C. Section 09 21 16 - Gypsum Board Assemblies: Acoustic insulation inside walls and partitions.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2021.

B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).

D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

1.05 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 - PRODUCTS

2.01 APPLICATIONS

A. Insulation Over Wood Stud Framed Walls, Continuous: Mineral fiber board.

B. Insulation in Wood Framed Walls: Batt insulation

C. Insulation Over Roof Deck: Polyisocyanurate board.

2.02 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.

1. Type and Compressive Resistance: Type VI, 40 psi (276 kPa), minimum.

2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.

3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.

4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.

5. Manufacturers:

a. Dow Chemical Company; STYROFOAM HIGHLOAD 40: www.dowbuildingsolutions.com/#sle.

b. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle .

c. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle .

d. Or Equal.

e. Substitutions: See General Conditions 7.06, Substitutes.

2.03 FIBERBOARD INSULATION MATERIALS

A. Mineral Fiberboard Insulation installed exterior of sheathing: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.

1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.

2. Board Size: Largest size possible to cover areas shown on plans.

3. Board Thickness: 1 inch (25 mm) or as needed to achieve R-value shown on plans.

4. Thermal Resistance: R-value (RSI-value) of 4.3 (0.76) per inch at 75 degrees F (24 C), minimum, when tested according to ASTM C518.

5. Manufacturers:

a. ROCKWOOL (ROXUL, Inc); ROCKBOARD 80: www.rockwool.com/#sle.

b. Or Equal.

c. Substitutions: : See General Conditions 7.06, Substitutes.

2.04 BATT INSULATION MATERIALS

A. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.

1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.

2. Thermal Resistance: R-value (RSI-value) of 24 .

3. Manufacturers:

a. ROCKWOOL (ROXUL, Inc); COMFORTBATT: www.rockwool.com/#sle .

b. Or Equal.

c. Substitutions: : See General Conditions 7.06, Substitutes.

2.05 ACCESSORIES

A. Insulation Fasteners: Appropriate for purpose intended and per insulations manufacturer's written instructions..

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.

1. Install in running bond pattern.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION OVER LOW SLOPE ROOF DECK

A. Installation of board insulation over low slope roof deck as specified in Section 07 41 13 Metal Roof Panels.

B. Board Installation Over Roof Deck, General:

1. See applicable roofing specification section for specific board installation requirements.

2. Ensure vapor retarder is clean and dry, continuous, and ready for application of roofing system.

3. Fasten insulation to deck in accordance with roofing manufacturer's written instructions and applicable Factory Mutual requirements.

4. Do not apply more insulation than can be covered with roofing on the same day.

3.04 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in exterior wall spaces without gaps or voids. Do not compress insulation.

C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

END OF SECTION

SECTION 07 25 00

WEATHER BARRIERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

C. Section 07 92 00 - Joint Sealants: Sealing building expansion joints.

D. Section 09 21 16 - Gypsum Board Assemblies: Water-resistive barrier under exterior cladding.

1.03 DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.

1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams. Correctly installed exterior air barrier membranes are inherently water resistive.

1.04 REFERENCE STANDARDS

A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.

B. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2022.

C. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2017.

D. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.

1.05 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 - PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

A. Air Barrier:

1. On outside surface of sheathing of exterior walls use air barrier sheet, mechanically fastened type.

2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

A. Air Barrier Sheet, Mechanically Fastened:

1. Air Permeance: 0.004 cfm/sq ft (0.02 L/(s sq m)), maximum, when tested in accordance with ASTM E2178.

2. Water Vapor Permeance: 5 perms (286 ng/(Pa s sq m)), minimum, when tested in accordance with ASTM E96/E96M Procedure A (Desiccant Method) at 73.4 degrees F (23 degrees C).

3. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 180 days of weather exposure.

4. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 50 or less, when tested in accordance with ASTM E84.

5. Seam and Perimeter Tape: Polyethylene self adhering type, mesh reinforced, 2 inches (50 mm) wide, compatible with sheet material; unless otherwise specified.

6. Manufacturers:

a. DuPont de Nemours, Inc; Tyvek Commercial Wrap with Tyvek Fluid Applied Flashing - Brush Formulation, Tyvek Fluid Applied Flashing and Joint Compound, FlexWrap NF, StraightFlash, StraightFlash VF, Tyvek Wrap Caps, and Tyvek Tape: www.dupont.com/#sle.

b. Fortifiber Building Systems Group; WeatherSmart: www.fortifiber.com/#sle

c. Fortifiber Building Systems Group; WeatherSmart Drainable: www.fortifiber.com/#sle

d. Fortifiber Building Systems Group; WeatherSmart Commercial: www.fortifiber.com/#sle

e. Kingspan Insulation LLC; GreenGuard RainDrop Building Wrap: www.trustgreenguard.com/#sle

f. Kingspan Insulation LLC; GreenGuard MAX Building Wrap: www.trustgreenguard.com/#sle

g. VaproShield, LLC; WrapShield IT - Integrated Tape: www.vaproshield.com/#sle

h. VaproShield, LLC; RevealShield IT - Integrated Tape: www.vaproshield.com/#sle

i. Or equal.

j. Substitutions: See General Conditions 7.06, Substitutes.

2.03 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

A. Interior Vapor Retarder Sheet: Nylon-based sheet.

1. Water Vapor Permeance: 0.3 perm (17 ng/(Pa s sq m)), maximum, when tested in accordance with ASTM E96 Desiccant Method and 10 perm minimum, when tested in accordance with ASTM E96 Water Method.

2. Seam and Perimeter Tape: Manufacturer's recommended self adhering tape, compatible with sheet material.

3. Manufacturers:

a. Certainteed; MemBrain, www.certainteed.com.

b. Or Equal..

c. Substitutions: See General Conditions 7.06, Substitutes.

2.04 ACCESSORIES

A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.

1. Composition: Butyl rubber sheet laminated to elasticized polyethylene sheet.

2. Manufacturers:

a. DuPont de Nemours, Inc; StraightFlash: www.dupont.com/#sle .

b. DuPont de Nemours, Inc; StraightFlash VF: www.dupont.com/#sle .

c. GCP Applied Technologies, Inc. Grace Ultra.

d. Or equal.

e. Substitutions: See General Conditions 7.06, Substitutes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

B. Clean and prime substrate surfaces to receive adhesives in accordance with manufacturer's instructions.

3.03 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

C. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.

D. Mechanically Fastened Sheets - On Exterior:

1. Install sheets shingle-fashion to shed water, with seams generally horizontal.

2. Overlap seams as recommended by manufacturer but at least 6 inches.

3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches (305 mm).

4. For applications specified to be air tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.

5. Install air barrier and vapor retarder underneath the jamb flashings.

6. Install head flashings under weather barrier.

7. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.

E. Mechanically Fastened Sheets - Vapor Retarder On Interior:

1. When insulation is to be installed in assembly, install vapor retarder over insulation.

2. Anchor to wood framing using large-headed nails or staples at 12 to 18 inches (305 to 460 mm) on center along each framing member covered; cover fasteners with seam tape.

3. Seal seams, laps, perimeter edges, penetrations, tears, and cuts with self-adhesive tape, making air tight seal.

4. Locate laps at a framing member; at laps fasten one sheet to framing member then tape overlapping sheet to first sheet.

5. Seal entire perimeter to structure, window and door frames, and other penetrations.

6. Where conduit, pipes, wires, ducts, outlet boxes, and other items are installed in insulation cavity, pass vapor retarder sheet behind item but over insulation and maintain air tight seal.

F. Self-Adhered Sheets:

1. Prepare substrate in manner recommended by sheet manufacturer; fill and tape joints in substrate and between dissimilar materials.

2. Lap sheets shingle-fashion to shed water and seal laps air tight.

3. Once sheets are in place, press firmly into substrate with resilient hand roller; ensure that laps are firmly adhered with no gaps or fishmouths.

4. Use same material, or other material approved by sheet manufacturer for the purpose, to seal to adjacent construction and as flashing.

5. At wide joints, provide extra flexible membrane allowing joint movement.

G. Coatings:

1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.

2. Where exterior masonry veneer is to be installed, install masonry anchors before installing weather barrier over masonry; seal around anchors air tight.

3. Use flashing to seal to adjacent construction and to bridge joints.

H. Openings and Penetrations in Exterior Weather Barriers:

1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches (125 mm) onto weather barrier and at least 6 inches (150 mm) up jambs; mechanically fasten stretched edges.

2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches (100 mm) wide; do not seal sill flange.

3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches (230 mm) wide, covering entire depth of framing.

4. At head of openings, install flashing under weather barrier extending at least 2 inches (50 mm) beyond face of jambs; seal weather barrier to flashing.

5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 FIELD QUALITY CONTROL

A. See Section 01 45 23 – Testing and Inspections, for additional requirements.

B. Coordination of ABAA Tests and Inspections:

1. Provide testing and inspection required by ABAA QAP.

2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.

3. Cooperate with ABAA testing agency.

4. Allow access to air barrier work areas and staging.

5. Do not cover air barrier work until tested, inspected, and accepted.

C. Do not cover installed weather barriers until required inspections have been completed.

D. Take digital photographs of each portion of the installation prior to covering up.

3.05 PROTECTION

A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 30 12

ROOFING UNDERLAYMENT, EXTENDED HIGH-TEMPERATURE

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, 300F resistance, extended period, Ultratm, or equal.

B. Related Sections: Refer to the following specification sections for coordination:

1. Section 06 10 00 – Rough Carpentry.
2. Section 07 41 13 – Metal Roof Panels.
3. Section 07 62 00 – Sheet Metal Flashing and Trim
4. Section 07 92 00 – Joint Sealants

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.

B. Or Equal

2.02 MATERIALS

A. Basis of Design: Self-Adhering Sheet Membrane Roof Underlayment: Provide Ultra by GCP Applied Technologies, Inc with the following characteristics:

1. Cold applied, self-adhering membrane composed of a high strength polyethylene film coated on one side with a layer of butyl rubber adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is provided on the polyethylene.
2. Color: Gray-black.
3. Membrane Thickness 30 mil (0.76 mm) ASTM D3767 method A.
4. Tensile strength, Membrane: 250 psi (1720 kN/m2) ASTM D412 (Die C modified).
5. Elongation, Membrane: 250% ASTM D412 (Die C modified).
6. Low Temperature Flexibility: Unaffected @ -20°F (-29°C) ASTM D1970.
7. Adhesion to Plywood: 3.0 lbs/in width (525 N/m) ASTM D903.
8. Permeance (max): 0.05 Perms (2.9 ng/m2s Pa) ASTM E96.
9. Material Weight Installed (max): 0.22 lb/ft2 (1.1 kg/m2) ASTM D461.
10. Service Temperature: 300 degrees F (148.8 degrees C) per ASTM D1204
11. Primer: Water-based Perm-A-Barrier WB Primer by GCP Applied Technologies, Inc.
12. Code and Standards Compliance: Ultra meets the following requirements:
    a. ICC ESR-1677 approval according to AC-48 Acceptance Criteria for Self-Adhered underlayments used as Ice Barriers
    b. Underwriters Laboratories, Inc. R13399 Class A fire classification under fiberglass shingles and Class C under organic felt shingles.
    c. Underwriters Laboratories, Inc. Classified Sheathing Material Fire Resistance Classification Design Numbers P225, P227, P230, P237, P259, P508, P510, P512, P514, P701, P711, P717, P722, P723, P732, P734, P742, P824.

B. Or Equal

C. Substitutions :See General Conditions 7.06, Substitutes.

PART 3 - EXAMINATION

3.01 INSTALLATION

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.

B. 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.

3.02 CLEANING AND PROTECTION

A. 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

SECTION 07 41 13

METAL ROOF PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirement for Metal Roof Panels

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Roof sheathing.

B. Section 07 21 00 - Thermal Insulation: Rigid roof insulation.

C. Section 07 42 13 - Metal Wall Panels: Preformed wall panels.

D. Section 07 92 00 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2020.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

C. ASTM C1363 - Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus 2019.

D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.

E. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference 2005 (Reapproved 2017).

F. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference 1995 (Reapproved 2018).

G. ASTM E1680 - Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems 2016 (Reapproved 2022).

H. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems 2018.

I. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.

1. Show work to be field-fabricated or field-assembled.

2. Include structural analysis signed and sealed by qualified structural engineer, indicating compliance of roofing system to specified loading conditions.

C. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches (305 mm) square, representing actual roofing metal, thickness, profile, color, and texture.

1. Include typical panel joint in sample.

D. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

1. Accredited by IAS in accordance with IAS AC472.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.07 WARRANTY

A. See Section 01 78 36 – Warranties and Bonds, for additional warranty requirements.

B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of five years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: MP-1:

1. Metal Roof Panels: Versa Span manufactured by Taylor Metal Products.

2.02 METAL ROOF PANELS

A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.

B. Metal Panels: Factory-formed panels with factory-applied finish.

1. Profile: Standing seam, with 1.75" inch (45 mm) seam height; concealed fastener system lapped seam in standing seam profile.

2. Texture: Smooth, with intermediate ribs for added stiffness.

3. Length: Full length of roof slope, without lapped horizontal joints.

4. Width: Maximum panel coverage of 18 inches (457 mm).

C. Metal Soffit Panels:

1. Basis of Design: Soffit: Lifetime Soffit manufactured by Taylor Metal Products.

2. Profile: Solid Panel with no venting.

3. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.

4. Color: As selected by Architect from manufacturer's standard line.

2.03 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.04 FINISHES

A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss to match sample.

B. Finish Side: Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss as selected by Architect from manufacturer’s standard line.

C. Back Side: Siliconized Polyester Coating: Epoxy primer and silicone-modified polyester (SMP) enamel topcoat with minimum dry film thickness (DFT) of 0.8 mil (0.02 mm); color and gloss as selected from manufacturer’s standards.

2.05 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

1. Downspouts: Open face, rectangular profile. Color to match adjacent metal wall panel.

2. Gutters: SMACNA (ASMM) Rectangular Profile - Color to match Roof Metal Panel.

3. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurance of 1 in 10 years in accordance with SMACNA (ASMM).

4. Accessories: Profiled to suit Gutters and Downspouts.

5. Downspout Boots: Steel.

6. Seal Metal Joints.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:

1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

D. Underlayment: Synthetic non-asphaltic sheet, intended by manufacturer for mechanically fastened roofing underlayment without sealed seams.

1. Self Sealability: Passing nail sealability test specified in ASTM D1970/D1970M.

2. Low Temperature Flexibility: Passing test specified in ASTM D1970/D1970M.

3. Fasteners: As specified by manufacturer and building code qualification report or approval.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Broom clean wood sheathing prior to installation of roofing system.

B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.

C. Remove protective film from surface of roof panels immediately prior to installation. Strip film carefully, to avoid damage to prefinished surfaces.

D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roof panel manufacturer.

E. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project

conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.

1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.

2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.

B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.

1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by the panel manufacturer.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

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SECTION 07 42 13

METAL WALL PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels, with related flashings and accessory components.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wall panel substrate.

B. Section 07 21 00 - Thermal Insulation.

C. Section 07 25 00 - Weather Barriers: Weather barrier under wall panels.

D. Section 07 92 00 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

1.04 SUBMITTALS

A. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.

B. Samples: Submit two samples of each type of wall panel and soffit panel, 12 inches by 12 inches (305 mm by 305 mm) in size illustrating finish color, sheen, and texture.

C. Manufacturer's Qualification Statement.

D. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.

C. Prevent contact with materials that may cause discoloration or staining of products.

1.07 WARRANTY

A. See Section 01 78 36 – Warranties and Bonds, for additional warranty requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design:

1. Type: MP-2:

a. Metal Wall Panels - Exposed Fasteners: Classic 7/8" Corrugated Panel manufactured by Taylor Metal Products.

b. Or equal

c. Substitutions: See General Conditions 7.06, Substitutes

2. Type: MP-3:

a. Metal Wall Panels - Exposed Fasteners: BR-36 Panel manufactured by Taylor Metal Products.

b. Or equal

c. Substitutions: See General Conditions 7.06, Substitutes

2.02 MANUFACTURED METAL PANELS

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.

1. Provide exterior wall panels.

2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.

3. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.

4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.

5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.

7. Corners: Factory-fabricated in one continuous piece with minimum 2 inch (51 mm) returns.

8. Provide continuity of air barrier and vapor retarder seal at building enclosure elements in accordance with materials specified in Section 07 25 00.

B. Exterior Wall Panels:

1. Basis of Design Type: MP-2:

a. Classic 7/8' corrugated.

b. Or Equal.

c. Substitutions: See General Conditions 7.06, Substitutes

d. Profile: Vertical style as indicated

e. Side Seams: sealed per manufacturer's written instructions.

f. Color: As selected by Architect from manufacturer's standard line.

2. Basis of Design Type: MP-3:

a. BR-3 manufactured by Taylor Metal Products

b. Or Equal.

c. Substitutions: See General Conditions 7.06, Substitutes

d. Profile: Vertical; style as indicated.

e. Side Seams: sealed per manufacturer's written instructions.

f. Material: Precoated steel sheet, 22 gage, 0.0299 inch (0.76 mm) minimum thickness.

g. Panel Width: 32 inches (813 mm).

h. Color: As selected by Architect from manufacturer's standard line.

C. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

D. Expansion Joints: Same material, thickness and finish as exterior sheets; manufacturer's standard brake formed type, of profile to suit system.

E. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

F. Anchors: Per manufacturer's written instructions..

2.03 MATERIALS

A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 FINISHES

A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.

B. Panel Backside Finish: Panel manufacturer's standard siliconized polyester wash coat.

2.05 ACCESSORIES

A. Cladding Support Clips: Manufacture’s standard panel support clip.

1. Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 galvanized coating.

B. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.

C. Concealed Sealants: Non-curing butyl sealant or tape sealant.

D. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.

E. Fasteners: Manufacturer's standard type to suit application.

F. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.

B. Verify that weather barrier has been installed over substrate completely and correctly.

3.02 PREPARATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

3.03 INSTALLATION

A. Install panels on walls in accordance with manufacturer's instructions.

B. Use concealed fasteners unless otherwise approved by Architect.

3.04 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch (1.6 mm).

B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch (6.4 mm).

3.05 CLEANING

A. Remove site cuttings from finish surfaces.

B. Remove protective material from wall panel surfaces.

C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

D. Upon completion of installation, thoroughly clean prefinished aluminum surfaces in accordance with AAMA 609 & 610.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.

B. Sealants for joints within sheet metal fabrications.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.

B. Section 07 41 13 - Metal Roof Panels - Downspouts and Gutters

C. Section 07 42 13 - Metal Wall Panels

D. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2021.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2021, with Errata (2022).

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2020.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

H. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

I. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2018).

J. CDA A4050 - Copper in Architecture - Handbook current edition.

K. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 - PRODUCTS

2.01 SHEET MATERIALS

A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage, (0.0239) inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.

1. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.

2. Color: As selected by Architect from manufacturer's standard colors.

B. Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) (0.81 mm) thick; anodized finish of color as selected.

C. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) (0.81 mm) thick; plain finish shop pre-coated with modified silicone coating.

1. Modified Silicone Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.

2. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.

D. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gage, (0.0156 inch) (0.40 mm) thick; smooth No. 4 - Brushed finish.

E. Copper: ASTM B370, cold rolled 16 oz/sq ft (24 gage) (0.0216 inch) (0.55 mm) thick; natural finish.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch (450 mm) long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.03 GUTTER AND DOWNSPOUT FABRICATION

A. See Specification Section 07 41 13 Metal Roof Panels

B. Downspout Boots: Steel.

C. Seal metal joints.

2.04 EXTERIOR PENETRATION FLASHING PANELS

A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.05 ACCESSORIES

A. Fasteners: Galvanized steel, with soft neoprene washers.

B. Primer: Zinc chromate type.

C. Concealed Sealants: Non-curing butyl sealant.

D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

A. Comply with drawing details and SMACNA standard installation practices.

B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

C. Apply plastic cement compound between metal flashings and felt flashings.

D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

E. Secure gutters and downspouts in place with concealed fasteners.

F. Connect downspouts to downspout boots, and grout connection watertight.

3.03 FIELD QUALITY CONTROL

A. See Section 01 45 23 – Testing and Inspections, for field inspection requirements.

B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

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SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

D. Owner-provided field quality control.

1.02 RELATED REQUIREMENTS

A. Section 07 25 00 - Weather Barriers: Sealants required in conjunction with air barriers and vapor retarders.

B. Section 08 71 00 - Door Hardware: Setting exterior door thresholds in sealant.

1.03 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015 (Reapproved 2022).

B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants 2018.

C. ASTM C834 - Standard Specification for Latex Sealants 2017.

D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2022.

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.

F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.

G. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.

H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.

I. ASTM C1311 - Standard Specification for Solvent Release Sealants 2014.

J. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.

K. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2019 (Reapproved 2020).

L. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).

M. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.

N. SCAQMD 1168 - Adhesive and Sealant Applications 1989, with Amendment (2017).

O. UL 263 - Standard for Fire Tests of Building Construction and Materials Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.

1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.

2. List of backing materials approved for use with the specific product.

3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.

4. Substrates the product should not be used on.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

E. Installation Plan: Submit at least four weeks prior to start of installation.

F. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

G. Installation Log: Submit filled out log for each length or instance of sealant installed.

H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section and with at least five years of documented experience.

C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.

1. Adhesion Testing: In accordance with ASTM C794.

2. Compatibility Testing: In accordance with ASTM C1087.

3. Allow sufficient time for testing to avoid delaying the work.

4. Deliver to manufacturer sufficient samples for testing.

5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.

6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

D. Installation Plan: Include schedule of sealed joints, including the following.

1. Joint width indicated in Contract Documents.

2. Installation Log Form: Include the following data fields, with known information filled out.

a. Date of installation.

b. Name of installer.

c. Actual joint width; provide space to indicate maximum and minimum width.

d. Actual joint depth to face of backing material at centerline of joint.

e. Air temperature.

E. Owner will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.

1. Contractor shall cooperate with testing agency and repair failures discovered and destructive test location damage.

F. Field Quality Control Plan:

1. Visual inspection of entire length of sealant joints.

2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.

3. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

G. Field Adhesion Test Procedures:

1. Allow sealants to fully cure as recommended by manufacturer before testing.

2. Have a copy of the test method document available during tests.

3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.

4. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

H. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.

1.06 WARRANTY

A. See Section 01 78 36 – Warranties and Bonds, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.

1. Available products: Subject to compliance with requirements, suitable for it's function, and compatible with the adjacent material.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.

a. Wall expansion and control joints.

b. Joints between door, window, and other frames and adjacent construction.

c. Joints between different exposed materials.

d. Openings below ledge angles in masonry.

e. Other joints indicated below.

2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.

a. Joints between door, window, and other frames and adjacent construction.

b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.

c. Other joints indicated below.

3. Do not seal the following types of joints.

a. Intentional weepholes in masonry.

b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.

c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.

d. Joints where installation of sealant is specified in another section.

e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, non-curing.

2. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane "traffic-grade" sealant.

C. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.

1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.

2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.

3. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.

4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.

5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.

6. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.

7. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.

D. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

E. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.03 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

B. Colors: As listed below, to match adjacent surfaces, as approved by Engineer, and/or as indicated on drawings.

2.04 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus 100 percent and minus 50 percent, minimum.

2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.

3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.

B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 25 percent, minimum.

C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.

1. Color: White.

D. Hybrid Urethane Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 35 percent, minimum.

E. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.

F. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.

1. Movement Capability: Plus and minus 35 percent, minimum.

G. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.

H. Acrylic Latex Sealant: ASTM C834; for use as acoustical sealant and in firestopping systems for expansion joints and through penetrations.

1. Fire Rated System: Complies with UL 263 and ASTM E119 with UL fire resistance classifications.

I. Non-Curing Butyl Sealant: Solvent-based, single component, non-sag, non-skinning, non-hardening, non-bleeding; non-vapor-permeable; intended for fully concealed applications.

2.05 SELF-LEVELING SEALANTS

A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .

1. Movement Capability: Plus and minus 25 percent, minimum.

B. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single or multi-component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.

1. Movement Capability: Plus and minus 25 percent, minimum.

C. Rigid Self-Leveling Polyurethane Joint Filler: Two part, low viscosity, fast setting; intended for cracks and control joints not subject to significant movement.

1. Hardness Range: Greater than 100, Shore A, and 50 to 80, Shore D, when tested in accordance with ASTM C661.

D. Flexible Polyurethane Foam: Single-component, gun grade, and low-expanding.

E. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.

1. Composition: Multi-component, 100 percent solids by weight.

2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.

3. Joint Width, Minimum: 1/8 inch (3 mm).

2.06 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.

1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.

2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.

3. Open Cell: 40 to 50 percent larger in diameter than joint width.

4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.

E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Verify that backer rods are of the correct size.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Install bond breaker backing tape where backer rod cannot be used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

A. Perform field quality control inspection/testing as specified in PART 1 under QUALITY ASSURANCE article.

B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet (30 linear m), notify Architect immediately.

C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 00 Section "General Conditions".
2. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
3. Division 08 Section "Door Hardware".
4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.

10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.

11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.

13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.

14. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.

15. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

16. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.02 RELATED DOCUMENTS

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

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.

2. Details of doors, including vertical and horizontal edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.

5. Details of anchorages, joints, field splices, and connections.

6. Details of accessories.

7. Details of moldings, removable stops, and glazing.

8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40" above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.

2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

3. Smoke Control Door Assemblies: Comply with NFPA 105.

a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Pioneer Industries (PI).
4. Security Metal Products (SMP).
5. Or Equal.
6. Substitutions: See General Conditions 7.06, Substitutes

2.02 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 38 percent.

D. Frame Anchors: ASTM A653/A653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.03 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.

1. Design: Flush panel.

2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 "Laminated Core".

   a. Provide 22 gauge steel stiffeners at 6 inches on-center internally welded at 5" on- center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.

   b. Thermal properties to rate at a fully operable minimum U-Factor 0.37 and R-Value 2.7, including insulated door, thermal-break frame and threshold.

   c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.38 and R-Value 2.6, including insulated door, kerf type frame, and threshold.

3. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053 inch - 1.3-mm) thick steel, Model 2.

4. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).

5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.

6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".

7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:

1. Curries Company (CU) - Energy Efficient - 777 Trio-E Series.

2. Or Equal.

3. Substitutions: See General Conditions 7.06, Substitutes.

2.04 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall

construction. Fabricate with 1/16" positive thermal break and integral vinyl weatherstripping.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with A 653/A653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.

2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.

3. Manufacturers Basis of Design:

a. Curries Company (CU) – M Series.

b. Curries Company (CU) – Thermal Break TQ Series.

D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.

2. Manufacturers Basis of Design:

a. CECO Door Products (C) - SU Series.

b. Curries Company (CU) - M Series.

E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.05 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.

3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.06 LOUVERS

A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.

1. Blade Type: Vision proof inverted V or inverted Y.

2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.

2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.07 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.08 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.09 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.

2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.

3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.

4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

   a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.

5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.

7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.

8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

9. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

      1) Two anchors per jamb up to 60 inches high.

      2) Three anchors per jamb from 60 to 90 inches high.

3) Four anchors per jamb from 90 to 120 inches high.

4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.

2) Four anchors per jamb from 60 to 90 inches high.

3) Five anchors per jamb from 90 to 96 inches high.

4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.

3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.01 EXAMINATION

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

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

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

3.02 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.03 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.

4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.

b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.

c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.04 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.05 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION

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SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Overhead coiling doors, operating hardware, non-fire-rated and exterior; electrically operated.

B. Wiring from electric circuit disconnect to operator to control station.

1.02 RELATED REQUIREMENTS

A. Section 26 05 83 - Wiring Connections: Power to disconnect.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

C. ITS (DIR) - Directory of Listed Products current edition.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2008 (Reaffirmed 2020).

F. NEMA MG 1 - Motors and Generators 2018.

G. UL (DIR) - Online Certifications Directory Current Edition.

H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Product Data: Provide general construction, electrical equipment, and component connections and details.

C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.

D. Samples: Submit two slats, 12 by 12 inches (305 by 305 mm) in size illustrating shape, color and finish texture.

E. Manufacturer's Installation Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of type specified and with at least five years documented experience.

B. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.06 WARRANTY

A. See Section 01 78 36 – Warranties and Bonds, for additional warranty requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Overhead Coiling Doors:

1. The Cookson Company: www.cooksondoor.com/#sle.
2. Wayne-Dalton, a Division of Overhead Door Corporation: www.wayne-dalton.com/#sle.
3. Or Equal.
4. Substitutions: See General Conditions 7.06, Substitutes.

2.02 COILING DOORS

A. Exterior Coiling Doors: Steel slat curtain.

1. Capable of withstanding positive and negative wind loads of 20 psf (940 Pa), without undue deflection or damage to components.
2. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 8.1 (RSI-value of 1.43).
3. Nominal Slat Size: 3 inches (75 mm) wide by required length.
4. Finish: Factory painted, color as selected.
5. Guide, Angles: Finish to match curtain.
6. Hood Enclosure: Manufacturer's standard; primed steel.
7. Electric operation.
8. Mounting: Surface mounted.
9. Locking Devices: Slide bolt on inside.

2.03 MATERIALS AND COMPONENTS

A. Metal Curtain Construction: Hinged slats.

1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement. Finish to match slats.
2. Insulated Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position. Finish to match slats.

3. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.

4. Steel Slats: Minimum thickness, 24 gage, .0239 inch (.607 mm); ASTM A653/A653M galvanized steel sheet.

B. Guide Construction: Continuous, of profile to retain door in place, mounting brackets of same metal.

C. Guides - Angle: ASTM A36/A36M metal angles, size as required for wind loading.

D. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.

1. Minimum thickness; 24 gage, 0.020 inch (0.511 mm).

2. Prime paint.

E. Lock Hardware:

1. For motor operated units, additional lock or latching mechanisms are not required.

2. Slide Bolt: Provide on both-jamb sides, extending into slot in guides, with padlock on one side.

2.04 ELECTRIC OPERATION

A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by testing agency acceptable to authorities having jurisdiction.

1. Provide interlock switches on motor operated units.

B. Electric Operators:

1. Mounting: Side mounted.

2. Motor Enclosure:

a. Exterior Coiling Doors: NEMA MG 1, Type 4; open drip proof.

3. Motor Rating: 1/3 HP (250 W); continuous duty.

4. Motor Voltage: 120 volts, single phase, 60 Hz.

5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.

6. Controller Enclosure: NEMA 250, Type 4.

7. Opening Speed: 8-9 inches per second (203-228 mm/sec).

8. Brake: Manufacturer's standard type, activated by motor controller.

9. Manual override in case of power failure.

10. Refer to Section 26 05 83 for electrical connections.

C. Control Station: Provide standard three button (Open-Close-Stop) momentary-contact control device for each operator complying with UL 325.

1. 24 volt circuit.

2. Surface mounted, at interior door jamb.

3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.

a. Primary Device: Provide electric sensing edge, wireless sensing, NEMA 1 photo eye sensors, or NEMA 4X photo eye sensors as required with momentary-contact control device.

D. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.

C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.

D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

E. Coordinate installation of electrical service with Section 26 05 83.

F. Complete wiring from disconnect to unit components.

G. Install enclosure and perimeter trim.

3.03 TOLERANCES

A. Maintain dimensional tolerances and alignment with adjacent work.

B. Maximum Variation From Plumb: 1/16 inch (1.6 mm).

C. Maximum Variation From Level: 1/16 inch (1.6 mm).

D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet (3.2 mm per 3 m) straight edge.

3.04 ADJUSTING

A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

A. Clean installed components.

B. Remove labels and visible markings.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.02 RELATED DOCUMENTS

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

1.03 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.

b. Manufacturer of each item.

c. Fastenings and other pertinent information.

d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

e. Explanation of abbreviations, symbols, and codes contained in schedule.

f. Mounting locations for door hardware.

g. Door and frame sizes and materials.

h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.

b. Complete (risers, point-to-point) access control system block wiring diagrams.

c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.04 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.

2. Plans for existing and future key system expansion.

3. Requirements for key control storage and software.

4. Installation of permanent keys, cylinder cores and software.

5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.

3. Review sequence of operation narratives for each unique access controlled opening.

4. Review and finalize construction schedule and verify availability of materials.

5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.06 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.07 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of the hardware.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Five years for exit hardware.

2. Twenty five years for manual overhead door closer bodies.

3. Five years for motorized electric latch retraction exit devices.

4. Two years for electromechanical door hardware, unless noted otherwise.

1.08 MAINTENANCE SERVICE

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

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in General Conditions 7.06, Substitutes. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.02 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.

b. Three Hinges: For doors with heights 61 to 90 inches.

c. Four Hinges: For doors with heights 91 to 120 inches.

d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.

b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.

b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in

hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. Bommer Industries (BO).

b. McKinney (MK).

c. Stanley Hardware (ST).

2.03 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

a. McKinney (MK) - QC (# wires) Option.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

a. McKinney (MK) - Electrical Connecting Kit: QC-R001.

b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

a. McKinney (MK) - QC-C Series.

2.04 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.

2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.

4. Tubular deadlocks and other auxiliary locks.

5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

6. Keyway: Manufacturer's Standard.

D. Removable Cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

E. Security Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed security cylinders and keys able to be used together under the same facility master or grandmaster key system. Cylinders to be factory keyed.

1. New security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.

2. Manufacturers:

a. Corbin Russwin (RU) - Access 3 AS.

b. Sargent (SA) - Degree DG2.

F. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.

2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.

3. New System: Key locks to a new key system as directed by the Owner.

G. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)

2. Master Keys (per Master Key Level/Group): Five (5).

3. Construction Keys (where required): Ten (10).

H. Construction Keying: Provide construction master keyed cylinders.

I. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

2. Provide transcript list in writing or electronic file as directed by the Owner.

2.05 ELECTROMECHANICAL LOCKING DEVICES

A. Electromechanical Mortise Locksets, Grade 1 (Heavy Duty, High Security Monitoring): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

3. High Security Monitoring: Provide lock bodies which have built-in request to exit monitoring and are provided with accompanying door position switches. Provide a resistor configuration which is compatible with the access control system.

4. Manufacturers:

   a. Corbin Russwin Hardware (RU) - ML20600 NAC Series.

   b. Sargent Manufacturing (SA) - NAC 8200 Series.

B. Electromechanical Mortise Locksets, Grade 1 (Commercial Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed, subject to same compliance standards and requirements as mechanical mortise locksets, electrified locksets to be of type and design as specified below.

1. Electrified Lock Options: Where indicated in the Hardware Sets, provide electrified options including: outside door lock/unlock trim control, latchbolt and lock/unlock status monitoring, deadbolt monitoring, and request-to-exit signaling. Support end-of-line resistors contained within the lock case. Unless otherwise indicated, provide electrified locksets standard as fail secure.

2. Manufacturers:

C. Electromechanical Multi-Point Locks: Vertical rod locking devices designed for openings requiring multiple latching points within one locking mechanism. Rods are retracted by dual mounted outside lever trim controls available in a variety of ANSI/BHMA operational functions. Option for single top latching only eliminates the need for bottom strikes. Electromechanical options include solenoid activated trim, electric latch retraction, and inside and outside lever monitoring.

1. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Manufacturers:

   a. Corbin Russwin Hardware (RU) MP9800 Series.

   b. Sargent Manufacturing (SA) - 7000 Series.

2.06 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.

2. Strikes for Bored Locks and Latches: BHMA A156.2.

3. Strikes for Auxiliary Deadlocks: BHMA A156.36.

4. Dustproof Strikes: BHMA A156.16.

2.07 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.

b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.

b. Sargent Manufacturing (SA) - 80 Series.

2.08 ELECTROMECHANICAL EXIT DEVICES

A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.

1. Energy Efficient Design: Provide devices which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.

3. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.

4. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED5000 Series.

b. Sargent Manufacturing (SA) - 80 Series.

2.09 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated

frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC6000 Series.

b. Norton Rixson (NO) - 7500 Series.

c. Sargent Manufacturing (SA) - 351 Series.

d. Yale Commercial(YA) - 4400 Series.

e. Or Equal.

f. Substitutions: See General Conditions 7.06, Substitutes.

2.10 ARCHITECTURAL TRIM

A. Door Protective Trim

General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

1. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

2. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

3. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

a. Stainless Steel: 300 grade, 050-inch thick.

4. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

5. Manufacturers:

a. Hiawatha, Inc. (HI).

b. Rockwood (RO).

c. Trimco (TC).

d. Or Equal.

e. Substitutions: See General Conditions 7.06, Substitutes.

2.11 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Hiawatha, Inc. (HI).

b. Rockwood (RO).

c. Trimco (TC).

d. Or Equal.

e. Substitutions: See General Conditions 7.06, Substitutes.

2.12 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko (PE).
3. Reese Enterprises, Inc. (RE).
4. Or Equal.
5. Substitutions: See General Conditions 7.06, Substitutes.

2.13 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

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

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

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.03 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

2. DHI TDH-007-20: Installation Guide for Doors and Hardware.

3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.04 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.05 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.06 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.07 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.08 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Manufacturer’s Abbreviations:

1. MK – McKinney
2. RO – Rockwood
3. SA – SARGENT
4. NO – Norton
5. PE – Pemko
6. SU - Securitron

SET: 1.0
Doors 412b

1	Cylinder	As Required	US32D	SA
1	Balance of Hardware	By Door Mfg.		

SET: 2.0
Doors: 420a,420b

5	Hinge (Heavy Weight)	T4A3386 x NRP 4.5 x 4.5	US32D	MK
1	hinge (heavy weight)	T4A3386xNRP QC12 4-1/2" x 4-1/2"	US32D	MK
1	Concealed Vert. rod exit, exit only	19 43 MD8610 EO	US32D	SA
1	Fail Secure Exit Device	DG263 19 43 55 8976-24v ETL 815	US32D	SA
2	Door Closer	PR7500	689	NO
2	Kick Plate	K1050 10X1.5LDW CSK BEV	US32D-316	RO
2	Door stop	463-RKW	US32D	RO
1	Threshold	154SS FHSL14SS	-	PE
1	Rain Guard	346C	-	PE
1	Gasketing	S44GR	-	PE
2	Sweep	315SSN 36"	-	PE
1	Astragal	"Z" Type provided with HM Door	-	00
1	Frame Harness	QC-C1500 (as required)	-	MK
1	Door Harness	QC-C____ (as required)	-	MK
1	Card Reader	Provided by Access Control	-	-

SET: 3.0
Doors: 421a

2	Hinge (Heavy Weight)	T4A3386 x NRP 4.5 x 4.5	US32D	MK
1	hinge (Heavy weight)	T4A3386xNRP QC12 4-1/2" x 4-1/2"	US32D	MK
1	Electrified Mortise Lock	DG263 NAC-82271-24v LNL	US 32D	SA
1	Door Closer	PR7500	689	NO
1	Kick Plate	K1050 10X1.5LDW CSK BEV	US32D-316	RO
1	Doorstop	463-RKW	US32D	RO
1	Threshold	154SS FHSL14SS	-	PE
1	Rain Guard	346C	-	PE
1	Gasketing	S44GR	-	PE
1	Sweep	315SSN 36"	-	PE
1	Frame Harness	QC-C1500 (as required)	-	MK
1	Door Harness	QC-C____ (as required	-	MK
1	Card Reader	Provided by Access Control	-	-

SET 4.0

Doors: 871A, 871B

2	Hinge (Heavy Weight)	T4A3386 x NRP 4.5 x 4.5	US32D	MK
1	Hinge (Heavy Weight)	T4A3386xNRP QC12 4-1/2" x 4-1/2"	US32D	MK
1	Fail Secure Exit Device	DG263 19 43 55 8976-24v ETL	US32D	SA
1	Door Closer	PR7500	689	NO
1	Kick Plate	K1050 10X1.5LDW CSK BEV	US32D-316	RO
1	Threshold	154SS FHSL14SS	-	PE
1	Rain Guard	346C	-	PE
1	Gasketing	S44GR	-	PE
1	Frame Harness	QC-C1500 (AS REQUIRED)	-	MK
1	Door Harness	QC-C____ (AS REQUIRED)	-	MK
1	Card Reader	PROVIDED BY ACCESS CONTROL	-	-

NOTES: VERIFY EXISTING OPENING.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Insulating glass units.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.

B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.

B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015.

C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.

D. ASTM C1036 - Standard Specification for Flat Glass 2016.

E. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass 2014.

F. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2015.

G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.

H. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.

I. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2017.

J. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2014, with Errata (2017).

K. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2017.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

1.05 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).

1.06 WARRANTY

A. See Section 01 78 36 – Warranties and Bonds, for additional warranty requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Glass Fabricators:

1. GGI - General Glass International: www.generalglass.com/#sle
2. JE Berkowitz, LP: www.jeberkowitz.com/#sle
3. Standard Bent Glass Corp: www.standardbent.com/#sle
4. Viracon, Inc: www.viracon.com/#sle
5. Or equal.
6. Substitutions: See General Conditions 7.06, Substitutes.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
3. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.

1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:

1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
3. Solar Optical Properties: Comply with NFRC 300 test method.

2.03 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.

1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
2. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.

1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.04 INSULATING GLASS UNITS

A. Manufacturers:

1. AGC Glass North America, Inc: www.agcglass.com/#sle
2. Cardinal Glass Industries: www.cardinalcorp.com/#sle
3. Goldray Industries, Inc; Spandrel Glass: www.goldrayglass.com/#sle
4. Guardian Glass, LLC: www.guardianglass.com/#sle
5. Pilkington North America Inc: www.pilkington.com/na/#sle.Pilkington North America Inc: www.pilkington.com/na/#sle
6. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle
7. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle
8. Or equal.
9. Substitutions: See General Conditions 7.06, Substitutes.

B. Insulating Glass Units: Types as indicated.

1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
3. Metal Edge Spacers: Aluminum, bent and soldered corners.
4. Spacer Color: Black.
5. Edge Seal:
   a. Color: Black.
6. Purge interpane space with dry air, hermetically sealed.

PART 3 - EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Gypsum wallboard.

B. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

A. None.

1.03 REFERENCE STANDARDS

A. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.

B. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.

C. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base 2019.

D. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.

E. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2021.

F. GA-216 - Application and Finishing of Gypsum Panel Products 2021.

1.04 SUBMITTALS

A. See Section 01.33.00 - Submittals for submittal procedures.

B. Samples: Submit two samples of gypsum board finished with proposed texture application, 12 by 12 inches (300 by 300 mm) in size, illustrating finish color and texture.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five years of experience.

PART 2 - PRODUCTS

2.01 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:

1. American Gypsum Company: www.americangypsum.com/#sle.
2. CertainTeed Corporation: www.certainteed.com/#sle.
3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
4. USG Corporation: www.usg.com/#sle.
5. Or equal.

6. Substitutions: See General Conditions 7.06, Substitutes.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.

2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.

3. Thickness:

a. As shown on Drawings.

2.02 GYPSUM WALLBOARD ACCESSORIES

A. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.

1. Types: As detailed or required for finished appearance.

2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.

B. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.

C. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.

1. Exception: Tapered edges to receive joint treatment at right angles to framing.

3.03 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.04 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:

1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.

2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.

3. Level 3: Walls to receive textured wall finish.

4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.

1. Feather coats of joint compound so that camber is maximum 1/32 inch (0.8 mm).

C. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.

3.05 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.

END OF SECTION

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SECTION 09 91 13

EXTERIOR PAINTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.

2. Items indicated to receive other finishes.

3. Items indicated to remain unfinished.

4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.

5. Floors, unless specifically indicated.

6. Glass.

7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications 2019.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition.

C. SSPC-SP 1 - Solvent Cleaning 2015, with Editorial Revision (2016).

D. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Product Data: Provide complete list of products to be used, with the following information for each:

1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").

2. MPI product number (e.g. MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

4. Manufacturer's installation instructions.

5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.

C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating range of colors available for each finishing product specified.

1. Where sheen is specified, submit samples in only that sheen.

2. Allow 30 days for approval process, after receipt of complete samples by Architect.

3. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry, have been approved.

D. Manufacturer's Instructions: Indicate special surface preparation procedures.

E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Paint and Finish Materials: 1 gallon (4 L) of each color; from the same product run, store where directed.

2. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum five years documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.

1.07 MOCK-UP

A. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

    a. Vertical and Horizontal Surfaces: Provide samples of at least 25 sq. ft. (2.33 sq. m).

    b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on benchmark samples.

    a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

B. Provide door and frame assembly illustrating paint color, texture, and finish.

1. Locate where directed by Architect.

C. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.

2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.

B. Paints:

1. Behr Process Corporation: www.behr.com/#sle .

2. Cloverdale Paint, Brand Products of Rodda Paint Company: www.cloverdalepaint.com/#sle .

3. Diamond Vogel Paints: www.diamondvogel.com/#sle .

4. Dow Chemical Company: www.consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.

5. PPG Paints: www.ppgpaints.com/#sle .

6. Prosoco, Inc.: www.prosoco.com

7. Rainguard Brands, LLC.: www.rainguardpro.com

8. Rodda Paint Company: www.roddapaint.com/#sle .

9. Sherwin-Williams Company: www.sherwin-williams.com/#sle .

C. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each paint material in quantity required to complete entire project's work from a single production run.

3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Primed Metal.

1. Two top coats and one coat primer.

2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.

a. Products:

1) Behr Marquee Exterior Satin Enamel [No. 9450]. (MPI #15)

2) PPG Paints Speedhide Exterior Latex Satin, 6-2045XI Series. (MPI #15)

3) Rodda Protector Satin, 532201. (MPI #15)

4) Sherwin-Williams Resilience, Satin. (MPI #15)

5) Substitutions: See General Conditions 7.06, Substitutes.

B. Paint S-GR - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Sealer and Graffiti Control: Concrete, Concrete Masonry Units

C. Top Coat(s) and surface prep: per Manufacturer Recommendation:

1. Products:

a. Prosoco, Inc.: Sure Klean Weather Seal Blok-Guard & Graffiti Control 15

b. Rainguard Brands, LLC: Micro-Seal

c. or equal

d. Substitutions: See General Conditions 7.06, Substitutes

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Anti-Corrosive Alkyd Primer for Metal; MPI #79.

a. Products:

1) PPG Paints Speedhide Interior/Exterior Rust Inhibitive Steel Primer, 6-212 Series. (MPI #79)

2) PPG Paints: 4160 Series Multiprime Multi-Purpose Primer. (MPI #23, #76, #79, #95)

3) Rodda Barrier III HS Metal Primer, 708295. (MPI #79)

4) Or Equal.

5) Substitutions: See General Conditions 7.06, Substitutes.

2. Water Based Primer for Galvanized Metal; MPI #134.

a. Products:

1) Behr Premium Plus Interior/Exterior Multi-Surface Primer and Sealer [No. 436]. (MPI #134)

2) PPG Paints: 4020 PF Pitt-Tech Plus Interior/Exterior Waterborne Acrylic Primer Finish DTM Industrial Enamel. (MPI #134).

3) Sherwin-Williams DTM Primer/Finish (MPI #134)

4) Or Equal.

5) Substitutions: See General Conditions 7.06, Substitutes.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:

G. Masonry:

H. Ferrous Metal:

1. Solvent clean according to SSPC-SP 1.

2. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

I. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.

J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

3.06 COLOR SCHEDULE

Item	Tag on Drawing or Specs	Description	Location on/in Building
Paint – 1	PNT-1	White Paint	All Walls in Process Buildings/Spaces

END OF SECTION

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SECTION 09 91 23

INTERIOR PAINTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished andunless otherwise indicated.

1. Both sides and edges of plywood backboards for electrical and telecomequipment before installing equipment.

2. Prime surfaces to receive wall coverings.

D. Do Not Paint or Finish the Following Items:

1. Items factory-finished unless otherwise indicated; materials and productshaving factory-applied primers are not considered factory finished.

2. Items indicated to receive other finishes.

3. Items indicated to remain unfinished.

4. Fire rating labels, equipment serial number and capacity labels, bar codelabels, and operating parts of equipment.

5. Floors, unless specifically indicated.

6. Ceramic and other tiles.

7. Glass.

8. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

A. Section 09 91 13 - Exterior Painting.

1.03 DEFINITIONS

A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency current edition.

B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, andApplications 2019.

C. ASTM D4442 - Standard Test Methods for Direct Moisture ContentMeasurement of Wood and Wood-Based Materials 2020.

D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board 2020.

E. MPI (APSM) - Master Painters Institute Architectural Painting SpecificationManual Current Edition.

F. SCAQMD 1113 - Architectural Coatings 1977, with Amendment (2016).

1.05 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verifyacceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lotnumber, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area,and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substratesurface.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extentpossible.

B. Substitution of MPI-approved products by a different manufacturer ispreferred over substitution of unapproved products by the same manufacturer.

C. Paints:

1. Behr Process Corporation: www.behr.com/#sle.
2. Miller Paint Company: www.millerpaint.com
3. PPG Paints: www.ppgpaints.com/#sle.
4. Rodda Paint Co: www.roddapaint.com/#sle.
5. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
6. Or Equal.

D. Primer Sealers: Same manufacturer as top coats.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of beingreadily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each paint material in quantity required to complete entireproject's work from a single production run.

3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringentrequirements specified in the following:

a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.

b. SCAQMD 1113 Rule.

c. CARB (SCM).

2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants addedto a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Colors: As indicated on drawings.

2.03 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsumboard.

1. Two top coats and one coat primer.

2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144,145, 146, 147, or 148.

3. Top Coat Sheen:

a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations unless otherwise noted.

B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants,including metals and wood:

1. Medium duty applications include doors and door frames.

2. Two top coats and one coat primer.

3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #151,153 or 154.

4. Top Coat Sheen:

a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations unless otherwise noted.

5. Primer: As recommended by top coat manufacturer for specificsubstrate.

C. Transparent Finish on Concrete Floors.

1. 1 coat stain.

2. Sealer: Water Based Sealer for Concrete Floors; MPI #99.

3. Sealer Sheen:

a. Eggshell: MPI gloss level 3; use this sheen at all locations.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.

2. Interior/Exterior Latex Block Filler; MPI #4.

2.05 ACCESSORY MATERIALS

A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths,sanding materials, and clean-up materials as required for final completion of painted surfaces.

B. Patching Material: Latex filler.

C. Fastener Head Cover Material: Latex filler.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by the productmanufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Donot apply finishes unless moisture content of surfaces are below the followingmaximums:

1. Gypsum Wallboard: 12 percent.

2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

4. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer forachieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware,light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.E Concrete:

1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coatedexceeds that permitted in manufacturer's written instructions.

E. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceedthat permitted in manufacturer's written instructions. Allow to dry.

2. Prepare surface as recommended by top coat manufacturer.

F. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, andrinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects afterrepair.

H. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holesand cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

I. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaceswith clear sealer.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to drybefore next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified bymanufacturer.

D. Sand wood and metal surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust andparticles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, andfittings removed prior to finishing.

3.04 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metalcontainers, and remove daily from site.

3.05 PROTECTION

A. Protect finishes until completion of project.

END OF SECTION

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SECTION 09 96 00

HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Materials, surface preparation, application, curing, and inspection for industrial, high-performance coatings on interior and exterior surfaces.

B. Furnish all labor, materials, tools and equipment required to perform surface preparation, coating work, and inspection as specified. Perform all subsidiary and incidental work necessary to complete the work in conformance with the project requirements, to accomplish the approved end result of a totally protected and usable structure, including all attachments, accessories and appurtenances.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittals
2. Section 01 66 00 – Materials and Equipment
3. Section 01 99 90 – Reference Forms

1.03 DEFINITIONS

A. Abrasive: Material used for blast-cleaning, such as grit.

B. Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.

C. Anchor Pattern: Profile or texture of prepared surface(s).

D. Bug Holes: Small cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.

E. Coating/Lining Thickness: The total thickness of primer, intermediate and/or finish coats.

F. Dewpoint: Temperature of a given air/water vapor mixture at which condensation starts.

G. Dry Film Thickness (DFT): Depth of cured film, usually expressed in mils (0.001-inch). Use this definition as opposed to existing definition.

H. Drying Time: Time interval between application and curing of material.

I. Dry to Recoat: Time interval between application of material and ability to receive next coat.

J. Dry to Touch: Time interval between application of material and ability to touch lightly without damage.

K. Feather Edging: Reducing the thickness of the edge of paint.

L. Feathering: Operation of tapering off the edge of a point with a comparatively dry brush.

M. Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.

N. Hold Point: A defined point, specified in this Section 09 96 00, at which work shall be halted for inspection.

O. Holiday: A discontinuity, skip, or void in coating or coating system film that exposes the underlying substrate.

P. Honeycomb: Segregated condition of hardened concrete due to non-consolidation.

Q. Incompatibility: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.

R. Laitance: A layer of weak, non-durable concrete containing cement fine that is brought to the surface through bleed water as a result of concrete finishing/overfinishing.

S. Mil: 0.001-inch.

T. Overspray: Dry spray, particularly such paint that failed to strike the intended surface.

U. Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.

V. Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.

W. Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-sed material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.

X. Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.

Y. Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.

Z. Spreading Rate: Surface area covered by a unit volume of paint at a specific film thickness.

AA. Stripe Coat: (SSPC Guide 11) A separate coat of paint applied to all weld seems, pits, nuts/bolts/washers, and edges by brush. This coat shall not be applied until any previous coat(s) have cured and, once applied, shall be allowed to cure prior to the application of the subsequent coat(s).

BB. Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.

CC. Tie Coat: An intermediate coat used to bond different types of coatings. Coatings used to improve the adhesion of a succeeding coat.

DD. Touch-Up Painting: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.

EE. Volatile Organic Compound (VOC) Content: The portion of the coating that is a compound of carbon, is photo chemically reactive, and evaporates during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb/gal).

FF. Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.

GG. Weld Spatter: (NACE SPO-178) Beads of metal scattered near seam during welding.

HH. Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application. Wet film thickness is measured in mils or thousandths of an inch (0.001-inch) and is abbreviated WFT.

1.04 REFERENCES

A. ANSI – American National Standards Institute

B. ASTM – American Society for Testing and Materials

C. CSA – Canadian Standards Association

D. IAPMO – International Association of Plumbing and Mechanical Officials

E. SSPC – The Society for Protective Coatings

F. NACE International – National Association of Corrosion Engineers International

G. NSF International – National Sanitation Foundation International

H. UL – Underwriters Laboratories

I. WQA – Water Quality Association

1.05 SUBMITTALS

A. Comply with Section 01 33 00.

B. Finish Schedule

1. Submit a complete Finish Schedule that includes the surfaces in the Finish Schedule herein and any additional surfaces to be coated by the products submitted under this Section 09 96 00. Indicate the specific products and manufacturer for each item (equipment, substrate, or structure) to be coated.

2. Submit a color card or fan deck for each manufacturer and coating product submitted. Items in the complete Finish Schedule shall be confirmed with Owner-approved colors for each location prior to ordering materials.

C. Product Technical Data

1. Product Data Sheets: Submit coating manufacturer's technical data on products and recommended use. Include the brand name and series number of all coatings to be used. Submit product data sheets for all coating systems that include the following information:

a. VOC data.

b. Storage requirements.

c. Primer type, where required.

d. Maximum dry and wet mil thickness per coat.

e. Minimum and maximum curing time between coats and final cure times, including atmospheric conditions for each.

f. Curing time before submergence in liquid.

g. Thinners/solvents for reduction and cleaning.

h. Ventilation requirements.

i. Minimum and maximum atmospheric and substrate application conditions.

j. Allowable application methods.

k. Maximum allowable moisture content (concrete substrates).

l. Maximum shelf life.

2. Material Safety Data Sheets (MSDS): Submit coating manufacturer's Material Safety Data Sheets (MSDS) for products to be used on the project, including solvents, additives, cleaners, and thinners.

3. Surface Preparation Criteria: Submit coating manufacturer's surface preparation criteria, including recommended surface profile range after abrasive blasting.

4. Application Instructions: Submit Coating manufacturer's application instructions and equipment recommendation.

D. Certifications

1. VOC Content: Submit coating manufacturer's certification indicating that the submitted coatings meet regulations for allowable VOC content in the place of application and use intended.

2. NSF 61 Certification: Submit NSF 61 certification or listing for products applied to surfaces in contact with process (potable or to be treated to potable) water.

3. Compatibility Confirmation: Submit written confirmation by the shop and field applied coating manufacturers indicating that the compatibility between the shop and field applied coatings have been checked and approved by those manufacturers.

E. Coating Plan/Program

1. Cleaning and Abrasive Blasting Equipment: Submit abrasive blast cleaning and application equipment list and complete procedures for its use.

2. Coating System Treatment and Termination: Submit detailed, written instructions and/or graphic details for coating system treatment and coating system terminations for items to be coated in the project.

3. Overspray and Fugitive Dust Prevention: Submit contractor's written program for over spray prevention.

4. Recoating Information and Schedule: Submit information that defines the end date for field coating application for all equipment, machinery, and piping to ensure that the maximum recoat time for the shop applied primers will not be exceeded when field applied coatings are installed.

F. References and Qualifications

1. Manufacturer Project References: Submit a minimum of five project references, including current contact name, address, and telephone number where proposed coating products have been successfully used in similar coating applications within the past 5 years.

2. Applicator Project References: Submit a minimum of five project references, including current contact name, address, and telephone number where the Coatings Applicator has successfully performed similar coating work within the past 5 years.

3. Applicator Quality Assurance: Submit a letter from the selected and approved coating manufacturers for the project that verifies that the applicator meets the qualifications and quality assurance requirements in this Section (09 96 00).

4. Inspector Qualifications: Submit Qualifications for Quality Control personnel to be provided on site by the Contractor including, but not limited to, the inspector's NACE and SSPC Certification numbers for the certifications as requested in this Section (09 96 00).

1.06 QUALITY ASSURANCE

A. Regulatory Requirements

1. All work, materials, procedures, and practices under this Section (09 96 00) shall conform to the requirements of the applicable Federal, State, County, and local regulations and ordinances. The Contractor shall be responsible for securing any and all licenses, certificates, and permits required for the work at no additional cost to the Owner.

2. Prime and finish coat painting done at the project site or in locations other than the project site shall be in accordance with the air quality regulations in effect at the place the coating is applied.

3. All debris (liquid or solid) generated from surface preparation or coating activities shall be tested and disposed offsite in accordance with applicable Federal, State, County, and local regulations and ordinances. The Contractor shall be responsible for all required testing, monitoring, reporting, licenses, permits, and fees at no additional cost to the Owner.

B. Unit Responsibility

1. Assign unit responsibility for the materials, surface preparation, and coatings application to the Coatings Application Subcontractor .

2. Provide a certificate of Unit Responsibility. See Section 01 99 90.

C. Materials

1. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.

2. Each coating system shall have only one product used for the finish coat to ensure consistency in appearance throughout the project.

3. Delivery of coating system materials shall be in original, unopened containers with seals unbroken and labels intact. Labels shall identify type of material, color, and batch number. No material shall exceed six months from the original batch manufacturing date (No exceptions).

4. For repairs, the Contractor shall provide the same products, or products recommended by the coating manufacturer, as used for the original coating.

D. Qualifications

1. Coatings Manufacturer Requirements

a. Minimum of ten (10) years of successful experience manufacturing protective coatings. Submit list of references to demonstrate successful performance on comparable projects.

2. Coatings Applicator Requirements

a. Minimum of five (5) years practical experience and successful history in the application of similar products on comparable projects. Submit list of references.

E. Pre-Painting Conference

1. Schedule pre-painting conference with the Owner.

2. Do not proceed without holding a pre-painting conference with the Owner, Contractor, Inspector, Coating Applicator and Manufacturer.

3. Topics for discussion include:

a. Site conditions

b. Coating materials and manufacturer's application recommendations.

c. Surface preparation prior to abrasive blast cleaning.

d. Specification compliance of blast abrasives and surface profile requirements.

e. Schedule of field surface preparation and coating application, and order of the work.

f. List of equipment and procedures for cleaning, blasting, coating application, ventilation and dehumidification (if required).

g. Safety programs and the enforcement to be used during the course of the work.

h. Weather limitations for acceptable work.

i. Inspection facilities and equipment to be provided.

j. Hold points and inspector’s authority.

k. Establish non-conformance procedures, and chain of command and who signs off on completion of bringing the job back into compliance.

l. Procedures for over-spray prevention.

F. Coatings Applicator Personnel

1. Provide a supervisor at the work site during cleaning, surface preparation, and coating operations.

2. Provide skilled personnel qualified to perform work to industry standards of practice and safety, maintain continuity of personnel, and coordinate any transfer of personnel with the Owner.

G. Quality Control Requirements

1. The Contractor is responsible for ensuring that the surface preparation and coating activities meet the requirements of this specification. Observations by the Engineer, or a representative of the coating manufacturer, will not relieve or limit the Contractor's responsibilities.

2. Coatings application shall conform to requirements of this specification and the referenced standards. Changes in the coating system installation requirements will be allowed only with the written authorization of the Engineer before work commences.

3. The Contractor shall conduct the work and maintain appropriate and measurable quality control activities to ensure that the coating systems are installed as specified. Coating system work that does not conform to the Specifications or is otherwise not acceptable shall be corrected in accordance with the coating manufacturer's written procedures.

   a. Measure all dry film thicknesses. Readings shall be conducted as defined in SSPC-PA2.

   b. The ~~City~~Owner may, but is not required to, also measure coating thickness, at random locations, after each coat. SSPC –PA 2 (Level 1) is only to be used for the calibration of dry film thickness gauges. This is a minimum maximum dry film thickness specification. Dry film thickness readings will not be averaged. All inspection equipment shall be supplied by the Contractor. All equipment shall have current calibration certificates. The ~~City~~Owner reserves the right to use their own equipment at any time.

4. The Contractor shall prepare and submit coating work daily reports for each day while on site. The coating work daily reports shall be submitted to the Engineer no later than 1:00 p.m. the following workday. The coating work daily reports shall include the following:

   a. Number of coating applicator employees on site.

   b. Start and finish time of work shift.

   c. Climatic conditions at 4-hour intervals (i.e., partly cloudy, air temperature 78°F, relative humidity 63%, dew point 68°F, and WNW wind @ 4 mph).

   d. Major equipment on site regardless of utilization (i.e., trailers, air compressors, generators, spray pumps, scaffolding, aerial lifts, pressure washers, and sandblast pots).

   e. Inventory of coatings, solvents and abrasive media stored on site including information relative to deliveries received each day.

   f. Summary of work performed to include:

      1) Substrates/structures prepared (size, quantity, and location).

2) Surface preparation methods including materials consumed and equipment utilized.

3) Substrates/structures coated (size, quantity, and location).

4) Mixing method and time mixed (coating materials).

5) Induction time, pot life, and application start time.

6) Coating application methods including equipment utilized.

7) Application finish time.

8) Coating materials consumed [sequencing, product name, batch number(s) and manufacture date].

9) Problems encountered (i.e., equipment malfunctions or disruption/interference by other trades).

10) Accidents or near misses.

11) Quality control testing results.

H. On-site Inspection

1. The Contractor shall identify the points of access for inspection. The Contractor shall provide ventilation, ingress and egress, and other means necessary for the Owners' personnel to safely access the work areas.

2. The specified quality control tasks shall be performed by a NACE-certified inspector hired and paid for by the Owner.

3. Acceptance criteria for each Quality Control test shall be as indicated on the manufacturer's published data or in this specification, whichever is more stringent.

1.07 WARNINGS

A. Application of paint, epoxy, and protective coating materials may be hazardous. Take all necessary precautions to ensure the safety of workers and property.

B. Part of this work requires abrasive blasting. This may require the use of special equipment. Become familiar with the existing site conditions and take all steps necessary to protect adjacent facilities and personnel, at no additional cost to the Owner. Abrasive blasting and painting is called for in, on, or around mechanical equipment, which may be damaged by grit, dust, or painting overspray. Mask, wrap, enclose, and provide all protection required to safeguard this equipment at no additional cost to the Owner.

C. Perform abrasive blasting activities in a manner that will not cause nuisance.

1.08 EXTRA MATERIALS

A. Supply 1 gallon of each color, type, and surface texture. Store where directed.

B. Label each container with color, type, texture, and room locations, in addition to manufacturer's label.

1.09 WARRANTY

A. Provide material and workmanship warranty for coatings of 18 months from date of final acceptance by the Owner

B. Complete the Extended Warranty Form in Section 01 99 9.

C. See also Paragraph 3.10.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Products identified for each coating system are the product names from specific manufacturers. Coatings products from other manufacturers and of equal or higher quality and performance may also be acceptable.

1. Requests for Substitution of Alternative Coatings Products:

a. Include the full name of each product, descriptive literature, test data, data on past performance, manufacturer's instruction for use, generic type, and its nonvolatile content by volume.

b. Demonstrate product and performance is equivalent to the specified materials and complete systems.

c. Demonstrate that the coatings manufacturer has local qualified representation which will provide onsite technical support to resolve field problems with the manufacturer's products, materials or application for the duration of the project.

B. Requests for substitution of alternative coating products that decreases the specified dry-film thickness or the number of coats to be applied, or which changes the generic type of coating specified, will not be considered.

2.02 ABRASIVES FOR BLAST CLEANING

A. Use only new materials that are clean and free of contaminants.

B. Materials must be certified by the California Air Resources Board (CARB) for use in dry, open air abrasive blasting.

C. The Contractor shall use abrasive grit for field blast cleaning conforming to the following:

1. Produce a sharp angular surface profile of 1.5 to 2.5 mils

2. New, clean and free of contaminants (SSPC AB 1), and containing no hazardous materials.

D. Comply with all applicable requirements of Cal/OSHA and the Bay Area Air Quality Management District. Abrasives shall be certified by California Air Resources Board, Executive Order G-565.

E. Purchase only from firms which can accept spent abrasives, then process spent abrasives for recycle or proper disposal.

2.03 COATING SYSTEMS

A. System No. 1 – Zinc-Epoxy-Polyurethane System

1. Surface: Metal.

2. Service: Interior; exterior; exposed to direct sunlight; not immersed.

3. Surface Preparation

   a. Shop-Primed Metal

      1) Clean shop-primed surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning).

      2) Clean damaged shop-coated areas in accordance with SSPC SP-3 (Power Tool Cleaning) and recoat with specified primer.

      3) For factory-coated or shop-primed pumps, tanks, and other equipment, delete zinc-rich primer and use compatible primer as recommended by the coating manufacturer. All repair areas shall be abraded and de-glossed and feathered into a smooth transition.

   b. Bare Metal

      1) Prepare surface in accordance with SSPC SP-6 (Commercial Blast Cleaning) to 1.5 to 2.5 mil (Thin film systems)surface profile.

      2) For ductile iron pipe, prepare surfaces in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 50.

      3) Clean ferrous metal with bleeding in accordance with SSPC SP-11 (Power Tool Cleaning to Bare Metal).

      4) Spot blast areas of rust penetration to SSPC SP-10 (Near White Blast) and spot prime with specified primer.

   c. Galvanized Metal

      1) Clean damaged galvanized steel areas with exposed ferrous metal and/or rust in accordance with SSPC SP-5 (White Metal Blast Cleaning) or SSPC SP-11 (Power Tool Cleaned to Bare Metal) to achieve uniform 1.0 to 1.5 mil profile; spot prime with specified primer.

      2) Prepare galvanized, non-ferrous metal in accordance with SSPC SP-16 to impart uniform 1.0 to 1.5 mil profile.

      3) For galvanized steel, delete zinc primer.

4. Primer

   a. Field apply one coat of zinc-rich epoxy primer, or polyurethane primer where zinc-rich primer is to be omitted, compatible with urethane finish; comply with written instructions of coating manufacturer.

   b. Thickness: 3.0 to 4.0 dry mils.

   c. Products: Sherwin Williams, Zinc Clad 4100; Carboline, 859; or equal.

5. Intermediate

   a. Field apply one coat of intermediate or primer epoxy.

   b. Thickness: 5.0 to 6.0 dry mils.

   c. Product: Sherwin Williams, Macropoxy 646 FC; Carboline, Carboguard 890; or equal.

6. Finish

   a. Field apply one coat of polyurethane finish.

b. Thickness: 2.0 to 3.0 dry mils.

c. Product: Sherwin Williams, Hi Solids Polyurethane 250; Carbothane 134VOC; or equal.

B. System No. 2 – NSF Epoxy

1. Surface: Metal.

2. Service: Interior of tanks and other metal components in contact with water.

3. Surface Preparation

a. Shop-Primed Metal

1) Clean shop-primed surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC SP-3 (Power Tool Cleaning).

2) Clean damaged shop-coated areas in accordance with SSPC SP-5 (White Metal Blast Cleaning) and spot prime with specified primer. Cleaning shall produce a surface profile of 2.0 to 2.5 mils.

3) Shop epoxy primed surfaced shall require abrasive blasting or abrading per SSPC-SP 7 prior to receiving finish coats if the maximum recoat limit has been exceeded for the primer. This cleaning shall produce a uniform surface profile of 1.0 to 1.5 mils in the intact primer.

b. Bare Ferrous Metal

1) Prepare surface in accordance with SSPC SP-5 (White Metal Blast Cleaning) to 2.0 to 2.5 mil surface profile.

c. Nonferrous and Galvanized Metal

1) Prepare in accordance with SSPC SP-16 to achieve a uniform 1.0 to 1.5 mil profile.

4. System Thickness: Minimum 10 mils dry film.

5. Primer

a. Field apply one coat of the epoxy primer at the manufacturer's recommended dry film thickness.

b. Products: Sherwin Williams, Macropoxy 646; Carboline, Carboguard 691; or equal.

6. Finish

a. Field apply one or more coats of the epoxy finish at the manufacturer's recommended dry film thickness per coat to the specified system thickness.

b. Product: Sherwin Williams, Macropoxy 646; Carboline, Carboguard 691; or equal.

C. System No. 3 – Polyamidoamine Epoxy

1. Surface: Metal.

2. Service: Below grade (buried, exterior) in contact with soil.

3. Surface Preparation

a. Shop-Primed Metal

1) Clean shop-primed surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC SP-3 (Power Tool Cleaning).

2) Clean damaged shop-coated areas in accordance with SSPC SP-10 (Near White Metal Blast Cleaning) and spot prime with specified primer. Cleaning shall produce a surface profile of 2.0 to 2.5 mils.

3) Shop epoxy primed surfaced shall require abrasive blasting or abrading per SSPC-SP 7 prior to receiving finish coats if the maximum recoat limit has been exceeded for the primer. This cleaning shall produce a uniform surface profile of 1.0 to 1.5 mils in the intact primer.

b. Bare Ferrous Metal

1) Prepare surface in accordance with SSPC SP-10 (Near White Metal Blast Cleaning) to 2.0 to 2.5 mil surface profile.

4. System Thickness: Minimum 16 mils dry film.

5. Finish

a. Field apply two or more coats at the coating manufacturer's recommended dry film thickness per coat to the specified system thickness.

b. Product: Sherwin Williams, Macropoxy 646; Carboguard 890; or equal.

D. System No. 4 – Acrylic (Latex)

1. Surface: PVC and CPVC pipe.

2. Service: Exterior; direct sunlight exposure.

3. Surface Preparation

a. Clean plastic pipe with a solvent compatible with the specified primer.

b. Sand plastic pipe to uniformly abrade and de-gloss surfaces to achieve a surface profile of 1.0 to 1.5 mils. Vacuum clean after sanding to remove loose dust, plastic particles, and dirt.

4. System Thickness: Minimum 3 mils dry film.

5. Primer

a. Field apply one coat of acrylic primer.

b. Thickness: To the coating manufacturer's recommended dry film thickness.

c. Product: Sherwin Williams, Extreme Bond; Carboline, Sanitile 120; or equal.

6. Finish

a. Field apply one or more coats at the coating manufacturers recommended dry film thickness per coat to provide the specified system thickness.

b. Thickness: To system thickness.

c. Product: Sherwin Williams, Sher-Cryl HPA; Carboline, Carbocrylic 3359 DTM.

E. System No. 5 – Polyurethane

1. Surface: Concrete

2. Service: Interior, immersed

3. Surface Preparation:

a. Complete and cure concrete construction for 30 days or more before starting surface preparation work.

b. Prepare surfaces in accordance with SSPC-SP 13/NACE 6 or ICRI 03732 to obtain CSP 4 to 6 roughness

c. Eliminate leaks and infiltrations and remove standing water

d. Resurface areas with excessive cavities or exposed aggregate

e. Surface must be free of dust, condensation and visible moisture before application

4. System Thickness: 60 mils dry film

5. Primer

a. Field apply one coat of epoxy primer.

b. Thickness: To the coating manufacturer's recommended dry film thickness.

c. Product: Sherwin Williams, Macropoxy 5500LT or Corobond 100 Primer; Carboline Carboseal 720

6. Finish

a. Field apply one or more coats at the coating manufacturers recommended dry film thickness per coat to provide the specified system thickness.

b. Thickness: To system thickness.

c. Product: Sherwin Williams Poly-Cote 115; Carboline Reactamine 760

2.04 FINISH SCHEDULE

A. The following Finish Schedule identifies major structures, equipment, and substrates to be coated in accordance with this Section (09 96 00). The Finish Schedule is not intended to be a complete listing of all surfaces to be coated and other requirements may be identified elsewhere in the Specifications or on the Drawings. There may be additional surfaces for the project that require coating application which may not be listed in the Finish Schedule, and the Contractor shall be responsible for coating those surfaces in accordance with the requirements of this Section(09 96 00).

Structure	Substrate	Coating System	Color
Exposed Ferrous Metal Piping, Equipment, and Structures	Ferrous Metal	No. 1	Determined by Owner
Potable Water Piping, Exposed	Ferrous Metal	No. 2	Determined by Owner
Submerged DIP	Ferrous Metal	No. 3	Determined by Manufacturer
Exposed PVC Piping	Thermoplastic	No. 4	Determined by Owner

B. The Contractor shall be responsible to identify any surfaces for which there is a question about what standard coating system to apply. about what standard coating system to apply as part of the work covered by this Section (09 96 00) through a Request for Information.

PART 3 - EXECUTION

3.01 PRODUCT SHIPMENT, PROTECTION, AND STORAGE

A. Comply with Section 01 66 00.

B. Delivery

1. Deliver in original sealed containers identified with labels indicating manufacturer; product name and number; color, batch or lot number, and date of manufacture.

2. Note the date of manufacture and apply coatings prior to the expiration of the guaranteed storage life.

3. Coating materials exceeding storage life will be rejected.

C. Storage

1. Store coating materials in enclosed structures to protect from weather and excessive heat or cold.

2. Coatings stored at above or below manufacturers recommendations will be rejected.

3. Comply with state and local requirements for flammable materials.

3.02 SCAFFOLDING

A. Furnish, maintain, and remove scaffolding, ladders, planks required for application of coatings. Scaffolding, ladders, and rigging shall be designed for their intended use and shall comply with OSHA requirements.

B. Where requested by the Owner, provide ladders or scaffolding to facilitate inspection of the specified work.

3.03 HEALTH AND SAFETY REQUIREMENTS

A. General

1. Comply with the applicable health and safety requirements of OSHA and the recommendations of the product manufacturer.

2. Provide and require the use of proper personal protective and life-saving equipment for all persons visiting or working in or about the project site.

B. Ventilation: Ventilate work areas to control potential exposure and hazard to workers and employees of the plant.

1. Furnish and install temporary ventilation system to remove contaminated air, vapors, and other potential hazardous substances from confined spaces and interiors of containment structures. Forced air ventilation is required during blast cleaning, abrasive removal, coating application, and curing in confined spaces.

2. Ventilation system equipment shall be explosion proof, of industrial design, and of adequate capa~~city~~Owner to reduce the concentration of air contaminants to the degree that a hazard to workers or employees of the plant does not exist. Size ventilation system to maintain air changes within the confined space per OSHA regulations.

C. Illumination

1. Provide spark proof artificial lighting for all work in confined spaces.

2. Equip light bulbs with a protective cage to prevent breakage.

3. For lighting fixtures and bulbs, comply with the requirements of Section 70 of the National Fire Protection Association (NFPA), "National Electric Code", for the applicable atmosphere.

4. For lighting and other electrical systems, provide ground fault type, complying with NFPA 70.

5. Provide the following minimum illumination during all phases of work:

a. General work area: 25-Foot Candles.

b. Surface preparation and coating application: 30-Foot Candles.

c. Inspection: 50-Foot Candles per SSPC-Guide 12.

6. As directed by the Owner, provide additional illumination to fully illuminate all areas to be inspected.

D. Noise

1. Whenever the occupational noise exposure exceeds the maximum allowable sound level as set forth by OSHA regulations, the regional Air Pollution Control District and/or the ~~City~~Owner of Santa Cruz, provide and require the use of approved ear protection devices.

2. General maximum sound levels for the project are defined as those which will not affect routine facility or neighborhood activities.

3. Whenever levels are objectionable, or exceed these limits, adjust operations to reduce noise levels, as directed by the Owner or the local agency of jurisdiction.

E. Fire Extinguishers

1. Keep a minimum of two (2) ten pound (10-lb) ABC type fire extinguishers present in the work area whenever work is proceeding.

2. Train all personnel in the use of this type of fire extinguisher.

F. Comply with OSHA and applicable regulations and carefully follow the manufacturer's recommendations, precautions, and warnings regarding the handling and use of all surface preparation and coating materials and equipment.

G. Use coating equipment designed for application of the material specified and maintain in good working condition at all times.

3.04 ENVIRONMENTAL CONTROL

A. Carefully contain paints and solvents. Do not allow them to penetrate the soil.

B. Dispose of waste material in a legal manner. All stationary operating equipment shall be placed into secondary containment.

3.05 PREPARATION

A. General

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each Coating Systems Description. In the event of a conflict the Coating Systems Description shall take precedence.

2. Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old weathered coatings, and other foreign substances shall be removed. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free of contaminants which might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture to not cause detrimental contamination of the surfaces to be coated.

3. The Contractor shall verify at a minimum of two times daily that air supply is free of oil and moisture contamination (ASTM D-4285). The Contractor shall use effective oil and water separators in all main compressor airlines and shall be placed as close as practicable to the equipment. Prior to using compressed air, the Contractor shall test the quality of air downstream of the separators at suitable outlets by blowing the air on clean white blotter for 2 minutes to check for any contamination, oil, or moisture.

4. Cleaning and coating shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and painting operations. The Coating Inspector will examine surfaces after abrasive blast cleaning to verify

that all deposits of contaminants have been removed as per surface clean as per ISO 8502 (Class 2). The Contractor shall blow down and vacuum all surfaces prior to ~~City~~Owner inspection. Tank floors shall be vacuumed. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.

5. Containment: The Contractor shall erect and maintain protective enclosures as required to ensure that surface preparation debris, including dust, is contained within the immediate work area. All costs associated with containment shall be paid by the Contractor.

6. Dust and Contaminants: Protect substrate from excessive dust and airborne contaminants during coating application and curing. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

B. Abrasive Blast Cleaning

1. When abrasive blast cleaning is required to achieve the specified surface preparation the following requirements for blast cleaning materials and equipment shall be met:

   a. Used or spent blast abrasive shall not be reused on this project.

   b. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every four hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.

   c. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined in Item 2 above.

   d. Regulators, gauges, filters, and separators shall be in use on compressor air lines to blasting nozzles times during this work.

   e. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections.

   f. The air dryer shall be used and maintained for the duration of surface preparation work.

   g. The contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for both blast cleaning and inspection of the substrate during surface preparation work.

   h. If, between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, re-cleaning by water blasting, re-blasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.

   i. The contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to coatings work.

C. Solvent Cleaning

1. Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP-1 Solvent Cleaning shall be of the emulsifying type which emits no more than 340 g/l VOCs for AIM regions, 250 g/l for CARB regions and 100 g/l for SCAQMD regions, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.

2. Clean white cloths and clean fluids shall be used in solvent cleaning.

D. Ferrous Metal Substrates

1. Ferrous surfaces shall be prepared in accordance with applicable surface preparation specifications of SSPC/NACE specified for each coating system. Specific surface preparation requirements are stated in the Coating Systems Description. The profile depth of the surface to be coated shall be in accordance with the Coating Systems Description requirements and shall be measured by Method C of ASTM D4417. Blast particle size shall be selected by the Contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the coating manufacturer.

2. Preparation of ferrous metal surfaces shall be based upon comparison with SSPC-VIS1, and as described in the Coating Systems Description for each coating system. If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the contractor and the Owner and coated with a clear nonyellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.

3. Blast cleaning requirements for steel, and ductile-iron, are as follows:

   a. Ferrous steel piping shall be prepared in accordance with SSPC SP-6 and primed before installation.

   b. Ductile-iron piping surfaces including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 50.

   c. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application per ISO 8502 (Class 2).

   d. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.

E. Thermoplastic

1. Prepare surfaces of PVC by sanding to establish uniform surface roughness and to remove gloss from the substrate. Vacuum clean surfaces to remove loose dust, dirt, and other materials. Next, solvent clean using clean white rags and allow solvent to completely evaporate before application of coating materials.

3.06 APPLICATION

A. Workmanship

1. Coated surfaces shall be free from excessive runs, sags, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices. Minor and infrequent runs and sags which are within the total specified DFT plus a few mils – no more than 10% more mils than the specified total DFT shall be acceptable. Frequent runs or sags which exceed these limits or are detrimental to coating system performance are not acceptable.

2. The Contractor's spray equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and properly sized spray tips.

3. Each coating application be applied evenly and sharply cut to line. Care shall be exercised to avoid overspray or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.

4. Coating applications method shall be as recommended by the coating manufacturer.

5. Allow each coat to cure or dry thoroughly, according to the coating manufacturer’s printed instructions, prior to recoating.

6. Vary color for each successive coat for coating systems when possible. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cutouts, pits in steel surfaces, or rough surfaces with the prime coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

B. Coating Properties – Mixing and Thinning

1. Coatings, when applied, shall provide a satisfactory film and smooth even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Coating materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the coating manufacturer’s instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the coating may be thinned as recommended by the coating manufacturer immediately prior to use. The VOC of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the coating manufacturer.

2. Mixing of partial “kits” is strictly prohibited unless authorized in writing by the coating manufacturer and the Owner. This prohibition also applies to coatings

mixed for touchup or repairs. If authorized to mix partial kits, the contractor shall utilize containers with appropriate graduated markings/calibrated weight scales.

C. Environmental Conditions

1. Provide adequate heat, ventilation, and dehumidification to ensure that the coating manufacturer's environmental requirements are met and to ensure no loss of production days due to failure to meet coating manufacturer's environmental requirements.

2. Provide sufficient and continuous ventilation and air movement across coated substrates to remove volatile constituents (solvent) throughout the manufacturer's published curing period.

3. Air and surface temperatures: Prepare surfaces, apply and cure coatings within air and surface temperature range recommended by coating manufacturer.

4. Relative humidity: Prepare surfaces, apply and cure coatings within relative humidity range in accordance with coating manufacturer's instructions.

5. Dew Point: Do not apply coatings unless the temperature of the dew point is 5°F or greater than the temperature of the substrate.

6. Precipitation: Do not apply coatings in rain, snow, fog, or mist.

7. Wind: Do not spray apply coatings when the wind direction and velocity are such that overspray may result in property damage.

D. Protection of Coated Surfaces

1. Items which have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.

E. Film Thickness and Continuity

1. WFT of the first coat of the coating system and subsequent coats shall be verified by the contractor, during application of each coat.

2. Coatings shall be applied to the minimum dry film thickness specified as indicated on the CDS. Dry film thickness shall be determined using the appropriate industry standard for the substrate (SSPC-PA 2, SSPC-PA 9, or ASTM D1400). Coatings determined to be above the maximum dry film thickness, as indicated herein or on the coating manufacturer's product data sheet, will be removed at the Owner's discretion.

3. The Inspector may, but is not required to, also measure coating thickness, at random locations, after each coat. SSPC –PA 2 (Level 1) is only to be used for the calibration of dry film thickness gauges. This is a minimum maximum dry film thickness specification. Dry film thickness readings will not be averaged. All inspection equipment shall be supplied by the Contractor. All equipment shall have current calibration certificates. The Owner reserves the right to use their own equipment at any time.

4. In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the Owner shall determine the minimum conductivity for smooth areas of like coating where the dry mil thickness has been accepted. This conductivity shall be the minimum required for these rough or irregular areas. Pinholes and holidays shall be recoated to the required coverage.

5. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may be needed to be applied to achieve the specified dry film thickness.

6. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler-surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open air voids and "bug holes" in the concrete substrate are completely filled prior to coating application.

F. Special Requirements

1. Before erection, the Contractor shall apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces which are inaccessible after assembly. The final coat shall be applied after erection. Structural friction connections and high tensile bolts and nuts shall be coated after erection. Areas damaged during erection shall be hand-cleaned or power-tool cleaned and recoated with primer coat prior to the application of subsequent coats. Touch-up of surfaces shall be performed after installation. Surfaces to be coated shall be clean and dry at the time of application. Except for those to be filled with grout, the underside of equipment bases and supports that have not been galvanized shall be coated with at least two coats of intermediate coat specified for System 1 prior to setting the equipment in place. Provide coating system terminations at leading edges and transitions to other substrates in accordance with the coating manufacturer's recommendations or detail drawings.

G. Soluble Salt Contamination of Metal Substrates

1. Contractor shall test in accordance with SSPC Guide 15 metal substrates to be coated that have been exposed to sea water or coastal air or to industrial fallout of particulate or other sources of soluble chlorides (such as waste water exposure). If testing indicates chloride levels in excess of 25 ppm exist after the surface preparation has been completed. The Contractor shall reclean and prepare these surfaces until chloride levels are below 25 ppm.

3.07 EXCLUSIONS

A. Do not prepare or coat the following items or surfaces:

1. Mortar coated pipe and fittings

2. Sacrificial anodes and support wires

3. Copper, brass

4. Name Plates

5. Fiberglass items

B. Where surfaces specified as "not to be coated" are damaged, coated or otherwise do not comply with these Specifications, clean, repair or otherwise restore such surfaces to the satisfaction of the Owner, at no additional cost to the Owner.

3.08 INSPECTION AND TESTING

A. Perform inspection and testing as specified. Include additional inspection, sampling and testing work that the Owner may require to verify compliance with these Specifications.

B. Notify the Owner three (3) working days in advance of any field operations involving abrasive blast cleaning or coating applications.

C. Assistance to Owner

1. Coordinate work with the inspection, sampling and testing requirements of the Owner

2. Assist the Owner as required for the performance of duties.

3. Provide all lighting and scaffolding to enable the Owner to perform inspection and testing.

4. Provide the level of illumination and scaffolding locations for inspection purposes as directed by the Owner.

5. Furnish Owner with safety equipment and devices during abrasive blast cleaning, coating and painting operations. Provide a helmet with continuous fresh air supply for observation during cleaning operations and coating application.

D. The Owner will perform such tests as are required to help ensure compliance with all phases of the surface preparation, and application of the coating systems. Provide test equipment including, but not be limited to the following: SSPC surface preparation standards; surface profile test tape; micrometer; abrasive sieve test; ultraviolet lamp; sling psychrometer; mirror; certified thickness calibration plates; magnetic type dry film thickness gage; and a nondestructive holiday detector.

E. Inspection by the Owner does not relieve the Contractor of the responsibility of compliance with all the requirements of these specifications.

1. In cases of dispute concerning surface profiles, film thickness, film continuity (holidays), etc., the Owner’s measurements and tests shall be final. Abide by the Owner’s decisions and directives.

2. Correct deficiencies in the continuity of the coating, or painting film or in the dry film thickness by applying additional coats as required, at the sole expense of the Contractor.

F. The Owner will determine the degree and surface profile of the field blast cleaned surface per test method NACE RP0287. Perform additional blast cleaning over areas not conforming to the specified degree of surface preparation and surface profile.

G. Perform tests on surfaces of abrasively blast-cleaned steel to detect oil and other contaminants which might be deposited on surfaces as a result of abrasive blasting operations. This may include chemical tests or ultraviolet (black light) tests, as required.

H. Perform all mixing, thinning, application and holiday detection of coatings in the presence of the Owner.

I. The Owner may completely inspect each application of coating to determine thickness and integrity.

1. Each coating application will be checked and deficiencies marked.

2. After observing specified recoat time apply additional coating materials over areas not having the specified minimum dry film thickness and areas having any holidays or pinholes.

3. After correction of deficiencies, the Owner will re inspect those areas to determine the acceptability of the additional coating.

4. Each coating application must be one hundred (100) percent to the satisfaction of the Owner prior to proceeding with successive coating applications.

J. Dry Film Thickness Measurement

1. Use an approved magnetic type non destructive dry film thickness gauge.

2. Determine that the specified dry film thickness has been obtained.

3. Measure specified dry film thickness' above the peaks of the surface profile.

4. Perform as many dry film thickness measurements, as described in SSPC–PA2, as required to verify compliance with this specification. Use a Type II Constant Pressure Probe Dry Film Thickness Gauge.

K. Furnish calibrated inspection devices in good working condition for detection of holidays and measurement of dry film thickness.

1. Calibrate and operated per manufacturer's instructions.

2. Furnish U.S. Department of Commerce; National Bureau of Standards certified thickness calibrated plates to test the accuracy of dry film thickness gauges and certified instrumentation to test the accuracy of holiday detectors.

3. Keep dry film thickness gauges and holiday detectors available onsite at all times until final acceptance of the application.

L. Owner may elect to furnish inspection devices and render decisions based solely upon test results from these devices.

M. For coating film continuity detection tests on interior structure coated surfaces with 20 mils or less dry film thickness, use a nondestructive holiday detector.

1. Provide personnel to operate coating film continuity detection devices under the direction of the Owner.

2. Operate inspection devices per the manufacture’s recommendations in accordance with NACE SPO188.

3. Holiday test any tank lining or coatings that are to be used in immersion. The Contractor shall test all coated surfaces for pinholes (NACE SPO-188) and holidays after application of the final coat in accordance with the following:

a. Perform test in presence of the Owner’s Coating Inspector.

b. Perform test after coating has cured as recommended by the manufacturer.

c. Use an appropriate detector, such as Elcometer #236 or as approved by the Owner representative.

N. Test the coating integrity of the interior surfaces below the overflow line.

1. Mark all pinholes and repair manufacturer's written recommendations, or as directed by the Owner; and then retest.

2. Holidays or other irregularities are not permitted in the completed coating system.

3. During the testing, keep the detecting blade in continuous contact with the coated surface.

4. Do not proceed with holiday detection until the completed coating system has been cured per the manufacturer's recommendations.

O. Upon completion of the epoxy application to the interior structure surfaces, retest for holidays those areas of the lower shell which may have been subjected to abrasive blast rebound from the floor, repaired as noted herein. Repair areas as required and retest.

P. Measure anchor profile for prepared surfaces using a non destructive instrument such as a Testex Press O Film System.

Q. The Owner will verify completion of the final cure of the interior lining using a solvent wipe test.

1. Solvent wipe test: Consists of rubbing a solvent saturated rag on the area to be tested per ASTM D5402, using solvent recommended by manufacturer.

2. If any coating material is removed or the surface being tested becomes tacky, the coating is not fully cured. Extend curing time and if required continue dehumidification until the coating is fully cured.

R. The Owner may suspend the work if the cleaning and coating operations of the Contractor are creating a localized condition detrimental to facility operation, personnel or adjacent property. In the event of an intermittent or emergency suspension of the work by the Owner, correct deficiencies immediately.

S. Prepare, sign, and submit to the Owner daily inspection reports.

T. Nonconformance Reports

1. When a nonconformance report is required, prepare, sign, and submit to the Owner within one working day from the time that it is written.

2. After confirming that all non-conforming work has been corrected and/or the coating work is in compliance with this specification, prepare and submit a conformance verification report shall be completed for the specific item or area.

3. This report must be signed by the Inspector.

3.09 FINAL CLEANUP

A. Leave all areas in a neat and presentable condition.

B. Remove rubbish, construction debris and waste, surplus construction materials, scaffolding, tools, equipment, and coating, and thinner containers, and excess coating, and thinners, and other objectionable materials.

C. Dispose of such materials away from the site of work and in conformance with all applicable codes, ordinances and regulations.

D. Remove coating spots upon adjacent surfaces.

E. Clean, repair or refinish all damage to surfaces resulting from the work.

3.10 WARRANTY INSPECTION

A. Conduct a warranty inspection of all coating and painting work between the period of eleventh (11th) month through eighteenth (18th) month following final acceptance of the Contract work.

B. The Owner will establish the date for the inspection and will notify the Contractor at least 30 days in advance. The Owner may, by written notice to the Contractor, reschedule the warranty inspection to another date within the eleventh through eighteenth month inspection period, or may cancel the warranty period altogether.

C. Attendance

1. Attend the warranty inspection.

2. Notifying directly involved parties of the date and time of the inspection.

3. The Owner suggests personnel present at the pre-construction conference be present at this inspection.

D. Preparation

1. The Owner will completely drain and hose clean sufficiently for inspection.

2. Provide (Contractor) suitable lighting, ventilation and scaffolding for the structure inspection.

3. Use SSPC – Guide 12 for Illumination, and provide a minimum of 200 candle foot illumination for inspection.

E. Inspect visually the entire interior and exterior coating systems to determine whether any repair work is necessary or if a more detailed inspection will be needed.

F. Inspection Report

1. The Owner will prepare and deliver to the Contractor an Inspection Report.

a. The report will cover the warranty inspection, setting forth the number and types of failures observed, the percentage of the surface area where failure has occurred, and the names of the persons making the inspections.

b. Color photographs illustrating each type of failure will be included in the report.

c. A coating system failure is defined as any location where coatings have peeled off, bubbled, or cracked, and any location where rusting is evident.

d. Upon completion of inspection and receipt of Inspection Report, the Owner will establish a date for the Contractor to proceed with remedial work.

G. Commence repairs on the date established by the Owner and completed within one month (thirty days).

1. Repair all coating system failures.

a. Remove the deteriorated coating, clean the surface and recoat with the same coating system in strict accordance with the specification and manufacturer's recommendations, to the satisfaction of the Owner.

b. If the area of failure exceeds twenty five (25) percent of the area of a portion of the structures surface, then remove the entire coating system and recoat that surface. All costs for warranty inspection are the responsibility of the Contractor. Additional inspection and all costs for repair are the responsibility of the Contractor.

H. If the Contractor fails to complete the remedial work to the satisfaction of the Owner, the Owner may elect to perform the remedial work. The Contractor is liable for actual cost of all such remedial work, plus 20% for Owner’s administrative cost.

I. Perform final cleanup in accordance with this Section.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Room and door signs.

B. Interior directional and informational signs.

C. Building identification signs.

1.02 RELATED REQUIREMENTS

A. Section 26 51 00 - Interior Lighting: Exit signs required by code.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.

B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.

C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.

1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.

2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.

3. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.

F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.

G. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Package room and door signs in sequential order of installation, labeled by floor or building.

C. Store tape adhesive at normal room temperature.

1.07 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain this minimum temperature during and after installation of signs.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Flat Signs with cut-out letters: - See Drawings for Design Basis

B. Provide sheet metal of sufficient thickness to remain flat without oil-canning.

1. Metal to be powder-coated after cutting.

a. Color to be chosen by Architect from standard Kynar colors.

2. Provide colored acrylic behind cut-out letters - see drawings.

a. Color to be chosen by Architect from standard available colors.

C. Provide colored acrylic behind cut-out letters - see drawings.

1. Color to be chosen by Architect from standard available colors.

D. Sign to be mounted with 1" spacers from face of metal siding.

1. Best Sign Systems, Inc: www.bestsigns.com/#sle

2. FASTSIGNS: www.fastsigns.com/#sle

3. Inpro: www.inprocorp.com/#sle

4. Mohawk Sign Systems, Inc: www.mohawksign.com/#sle

5. Seton Identification Products: www.seton.com/aec/#sle

6. Or equal..

7. Substitutions: See General Conditions 7.06, Substitutes.

E. Dimensional Letter Signs:

1. A.R.K. Ramos Architectural Signage Systems; Cast Aluminum Letters: www.arkramos.com/#sle

2. Cosco Industries; Cast Aluminum: www.coscoarchitecturalsigns.com/#sle

3. FASTSIGNS: www.fastsigns.com/#sle

4. Inpro: www.inprocorp.com/#sle

5. Or equal..

6. Substitutions: See General Conditions 7.06, Substitutes.

2.02 SIGNAGE APPLICATIONS

A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.

B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.

1. Sign Type: Flat signs with engraved panel media as specified.

2. Provide "tactile" signage, with letters raised minimum 1/32 inch (0.8 mm) and Grade II braille.

3. See Drawings for Room and Door Sign templates including sizes and fonts.

4. Character Height: 1 inch (25 mm).

5. Sign Height: 2 inches (50 mm), unless otherwise indicated.

6. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings.

7. Conference and Meeting Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.

8. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.

9. Rest Rooms: Identify with pictograms, room numbers to be determined later, and braille.

C. Building Identification Signs:

1. Use individual metal letters.

2. Mount on outside wall in location indicated on drawings. See drawings for template Building Identification Sign including font and size.

3. Allow for 2 Building Identification Signs per Building

D. Other Dimensional Letter Signs: Wall-mounted.

1. Exterior: Allow for total of 50 letters, 6 inches (150 mm) high, metal.

2.03 SIGN TYPES

A. Flat Signs: Signage media without frame.

1. Edges: Square.

2. Corners: Square.

3. Wall Mounting of One-Sided Signs: Tape adhesive.

B. Color and Font: Unless otherwise indicated:

1. Character Font: Helvetica, Arial, or other sans serif font.

2. Character Case: Upper case only.

3. Background Color: Clear.

4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:

1. Total Thickness: 1/16 inch (1.6 mm).

2.05 DIMENSIONAL LETTERS

A. Metal Letters:

1. Metal: Aluminum casting.

2. Metal Thickness: Manufacturer's standard for letter size.

3. Letter Height: As indicated n Drawings.

4. Mounting: Concealed screws.

2.06 ACCESSORIES

A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.

B. Exposed Screws: Chrome plated.

C. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install neatly, with horizontal edges level.

C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.

D. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 14 13

PIPING AND VALVE IDENTIFICATION SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Identification systems for buried and exposed piping and valves.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 09 96 00 – High Performance Coatings
3. Section 40 05 10 – Piping Systems

1.03 SUBMITTALS

A. Comply with Section 01 33 00.

B. Include the following items:

1. Manufacturer's catalog information demonstrating compliance with the materials requirements of this section.
2. Samples of the materials to be used for piping and valve identification.
3. A schedule of piping services and description of identification systems.

PART 2 - PRODUCTS

2.01 PIPE CODING MARKERS

A. Manufacturers

1. One of the following or equal:
   a. Brady Company.
   b. Seton Name Plate Corporation.
   c. Industrial Safety Supply Corporation.

B. Comply with ANSI A13.1.

C. Type

1. Mechanically attached type that is easily removable.
2. Do not use adhesive applied type.
3. Pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe.

D. Legend and Backing

1. Resistant to petroleum based oils and grease.

2. Meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C.

E. Withstand a continuous operating temperature range of -40ºF to 180ºF.

F. Manufactured and applied in one continuous length of plastic. Do not provide individual letter type.

G. Provide in the following letter heights: For markers bearing the legends on the background colors specified in Section 40 05 10 (PIPESPEC).

Outside pipe diameter,[(a)] inches	Letter height, inches
Less than 1-1/2	1/2
1-1/2 through 3	1 1/8
Greater than 3	2-1/4
[(a)] Outside pipe diameter shall include insulation and jacketing.	

H. Include uni- and bi-directional arrows in the same sizes as the legend. Provide legends and arrows in white on blue or red backgrounds, and black on other specified backgrounds.

2.02 PLASTIC TRACER TAPE

A. Manufacturers

1. One of the following or equal:

a. Brady Company.

b. Seton Name Plate Corporation.

c. Industrial Safety Supply Corporation.

B. 6” wide, colored the same as the background colors as specified in Section 40 05 10.

C. Material: inert plastic material suitable for direct burial.

D. Capable of stretching to twice its original length.

E. Print two messages on the tape, both messages at maximum intervals of 2 feet.

1. First message: **“CAUTION CAUTION CAUTION PIPE BURIED BELOW”** with bold letters approximately 2” high.

2. Second message:

a. The blank in the first message shall contain the words **“NON-POTABLE WATER”** when used for W2 and IRR piping.

b. The blank in the first message shall contain the words **“RECLAIMED WASTEWATER”** when used for W3 piping.

c. The blank in the first message shall contain the words **“STORM DRAIN”** when used for SD piping.

d. The blank in the first message shall contain the word **“SEWER”** for all other piping systems.

2.03 MAGNETIC TRACER TAPE

A. Manufacturers

1. One of the following or equal:

a. Brady Co.

b. Seton Name Plate Corporation

c. Industrial Safety Supply Corporation.

B. Material

1. Acid and alkali-resistant polyethylene.

2. 3” wide.

3. 0.005” thick.

4. 1,500 psi strength and 140% elongation value.

C. Color the same as the background colors as specified in Section 40 05 10 and inscribe with the words **“CAUTION—PIPE BURIED BELOW”.**

2.04 VALVE IDENTIFICATION

A. Fabricate of stainless steel and inscribed with the specified valve number stamped in 1/4” high letters.

B. The label shall be of 1/16-inch thick stainless steel with a minimum size of 2 inches.

C. See Drawings for valve designation system.

PART 3 - EXECUTION

3.01 PIPING IDENTIFICATION

A. Pipe Coding

1. After application of the specified coating and insulation systems to new or existing piping, as specified in Section 09 96 00, identify exposed piping, interior and exterior, and piping in ceiling spaces, pipe trenches, pipe chases and valve boxes identified with plastic markers.

2. Locate legend markers and directional arrows at each side of walls, floors and ceilings, at one side of each piece of equipment, at piping intersections, and at approximately 50’ centers.

B. Plastic Tracer Tape

1. Provide a single line of plastic tracer tape as specified in this section, 2.5 feet above the centerline of each buried pipe.

2. Spread tape flat with message side up before backfilling.

C. Polyethylene Magnetic Tracer Tape

1. Install 12-18” below ground and parallel to all buried pipes.

3.02 VALVE IDENTIFICATION

A. Label all valves designated with a valve number where valve numbers are indicated on the Drawings.

B. Each label shall be permanently attached to the valve using stainless steel screws, stainless steel wire and connectors, or another method subject to approval.

C. Install tags on valve flanges in a position visible from floor level.

D. For flangeless valves 8” in diameter and larger, attach tags to the valve body by self-tapping corrosion resistant metal screws.

E. For flangeless valves 6” in diameter and smaller, attach tags to the valve stem by stainless steel wire. Use 0.063” wire minimum.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

B. Section 09 91 23 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide current edition.

B. NFPA 10 - Standard for Portable Fire Extinguishers 2022.

C. UL (DIR) - Online Certifications Directory Current Edition.

1.04 SUBMITTALS

A. See Section 01 33 00 - Submittals, for submittal procedures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:

1. Ansul, a Tyco Business: www.ansul.com/#sle .
2. Kidde, a unit of United Technologies Corp: www.kidde.com/#sle.
3. Nystrom, Inc: www.nystrom.com/#sle .
4. Oval Brand Fire Products; Oval Dry Chemical Fire Extinguisher - Multipurpose ABC: www.ovalfireproducts.com/#sle .
5. Potter-Roemer: www.potterroemer.com/#sle.
6. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
7. Or Equal.
8. Substitutions: See General Conditions 7.06, Substitutes.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.

1. Class: A:B:C type.

2. Temperature range: Minus 40 degrees F (Minus 40 degrees C) to 120 degrees F (49 degrees C).

2.03 FIRE EXTINGUISHER BRACKETS <ALL LOCATIONS EXCEPT ADMIN. BLDG.>

A. Manufacturer standard formed steel wall bracket.

2.04 ACCESSORIES

A. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure rigidly in place.

C. Place extinguishers on wall brackets.

END OF SECTION

SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.

B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Engineer Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.

C. Definitions:

1. Provide: To furnish and install, complete and ready for intended use.

2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.

3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.

4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.

5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.02 RELATED SECTIONS

A. Contents of Section applies to Division 23, HVAC Contract Documents.

B. Related Work:

1. Additional conditions apply to this Division including, but not limited to:

a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.

b. Drawings

c. Addenda

d. Owner/Engineer Agreement

e. Owner/Contractor Agreement

f. Codes, Standards, Public Ordinances and Permits

1.03 REFERENCES AND STANDARDS

A. References and Standards per Division 01, General Requirements, individual Division 23, HVAC Sections and those listed in this Section.

B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:

1. State of Oregon:

a. OAR - Oregon Administrative Rules

b. 2021 OESC - Oregon Electrical Specialty Code

c. 2019 OFC - Oregon Fire Code

d. 2019 OMSC - Oregon Mechanical Specialty Code

e. 2021 OPSC - Oregon Plumbing Specialty Code

f. 2019 OSSC - Oregon Structural Specialty Code

g. 2021 OEESC - Oregon Energy Efficiency Specialty Code

C. Reference standards and guidelines include but are not limited to the latest adopted editions from:

1. ABA - Architectural Barriers Act

2. ABMA - American Bearing Manufacturers Association

3. ADA - Americans with Disabilities Act

4. AHRI - Air-Conditioning Heating & Refrigeration Institute

5. AMCA - Air Movement and Control Association

6. ANSI - American National Standards Institute

7. ASCE - American Society of Civil Engineers

8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers

9. ASHRAE Guideline 0, The Commissioning Process

10. ASME - American Society of Mechanical Engineers

11. ASPE - American Society of Plumbing Engineers

12. ASSE - American Society of Sanitary Engineering

13. ASTM - ASTM International

14. AWWA - American Water Works Association

15. CFR - Code of Federal Regulations

16. CGA - Compressed Gas Association

17. CISPI - Cast Iron Soil Pipe Institute

18. EPA - Environmental Protection Agency
19. ETL - Electrical Testing Laboratories
20. FM - FM Global
21. GAMA - Gas Appliance Manufacturers Association
22. HI - Hydraulic Institute Standards
23. IAPMO - International Association of Plumbing & Mechanical Officials
24. IFGC - International Fuel Gas Code
25. ISO - International Organization for Standardization
26. MSS - Manufacturers Standardization Society
27. NEC - National Electric Code
28. NEMA - National Electrical Manufactures Association
29. NFPA - National Fire Protection Association
30. NFGC - National Fuel Gas Code
31. NRCA - National Roofing Contractors Association
32. NSF - National Sanitation Foundation
33. OSHA - Occupational Safety and Health Administration
34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
35. TEMA - Tubular Exchanger Manufactures Association
36. TIMA - Thermal Insulation Manufactures Association
37. UL - Underwriters Laboratories, Inc.

D. See Division 23, HVAC individual Sections for additional references.

1.04 SUBMITTALS

A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23, HVAC Sections.

B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.

C. In addition:

1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.

2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail or posted to ftp site and be native/searchable PDF format. Scanned copies are not acceptable. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. At Contractor's option, four separate submittals may be provided, consisting of long lead items, underground/site work, building work, and building automation system. Deviations will be returned without review.

3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23, HVAC Sections.

4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.

    a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.

    b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.

    c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.

    d. For vibration isolation of equipment, list make and model selected with operating load and deflection.

    e. See Division 23, HVAC individual Sections for additional submittal requirements outside of these requirements.

5. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.

6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.

7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.

8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.

9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.

10. Substitutions and Variation from Basis of Design:

    a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.

    b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.

    a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.

12. Samples: Provide samples when requested by individual Sections.

13. Resubmission Requirements:

a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.

1) Resubmit for review until review indicates no exception taken or make "corrections as noted".

2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.

14. Operation and Maintenance Manuals, Owner's Instructions:

a. Submit, at one time, electronic files (native/searchable PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.

1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.

2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.

3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Sections.

4) Include product certificates of warranties and guarantees.

5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.

6) Include copy of startup and test reports specific to each piece of equipment.

7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.

8) Include commissioning reports.

9) Include copy of valve charts/schedules.

10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal

Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration".

c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.

15. Record Drawings:

a. Maintain at site at least one set of drawings for recording “As-constructed” conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.

b. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.

c. At completion of project, input changes to original project CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD Files and drawings upon substantial completion.

d. See Division 23, HVAC individual Sections for additional items to include in record drawings.

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.

B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.

C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.

D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.

F. Provide products that are UL listed.

G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.

I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.06 WARRANTY

A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.07 COORDINATION DOCUMENTS

A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, equipment, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.

B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

C. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL listed and labeled or be approved by State, County, and City authorities prior to procurement and installation.

B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

C. Hazardous Materials:

1. Comply with local, State of Oregon, and Federal regulations relating to hazardous materials.

2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.

3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.

C. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request

clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.

D. Firestopping:

1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

E. Pipe Installation:

1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.

2. Include provisions for servicing and removal of equipment without dismantling piping.

F. Plenums:

1. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect / Engineer of any discrepancy.

3.02 SEISMIC CONTROL

A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 23 HVAC Sections.

B. General:

1. Earthquake resistant designs for HVAC (Division 23) equipment and distribution, i.e. motors, ductwork, piping, equipment, etc. to conform to regulations of jurisdiction having authority.

2. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to

withstand a force in direction equal to value defined by jurisdiction having authority.

3. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.

4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.

C. Piping and Ductwork:

1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.

D. Provide means to prohibit excessive motion of mechanical equipment during earthquake.

3.03 REVIEW AND OBSERVATION

A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:

1. Underground system installation prior to backfilling.

2. Prior to covering walls.

3. Prior to ceiling cover/installation.

4. After major equipment is installed.

5. When main systems, or portions of, are being tested and ready for inspection by AHJ.

C. Final Punch:

1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the mechanical systems are ready for final punch.

2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CUTTING AND PATCHING

A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of

proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).

2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.

3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.

5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.05 EQUIPMENT SELECTION AND SERVICEABILITY

A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

3.06 DELIVERY, STORAGE AND HANDLING

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.

2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.

3. Protect bright finished shafts, bearing housings and similar items until in service.

3.07 DEMONSTRATION

A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.08 CLEANING

A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.09 INSTALLATION

A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.

C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.

D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.

3.10 PAINTING

A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.

2. After acceptance by Authority Having Jurisdiction (AHJ), In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.

3. See individual equipment Specifications for other painting.

4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.

5. Piping and Ductwork: Clean, primer coat and paint exposed piping and ductwork on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.

6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.11 ACCEPTANCE

A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:

1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:

a. Testing and Balancing Reports
b. Cleaning
c. Operation and Maintenance Manuals
d. Training of Operating Personnel
e. Record Drawings
f. Warranty and Guaranty Certificates
g. Start-up/Test Document
h. Commissioning Reports

3.12 FIELD QUALITY CONTROL

A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

B. Tests:

1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.

2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.13 LETTER OF CONFORMANCE

A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.14 ELECTRICAL INTERLOCKS

A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.15 TEMPORARY HEATING, COOLING AND HUMIDITY CONTROL

A. Provide temporary heating, cooling, controls, humidification and dehumidification as required to facilitate the construction of the project. Size and select temporary system based on the requirements of the various trades during construction. This includes, but is not limited to, drywall, case work, wood flooring and wood finishes that are subject to warping. Size and install system to prevent mold growth. Coordinate the location of the temporary system. The house system can be used. Develop a procedure for how the house system will be used including a sketch depicting the house system, how filtration will be used to prevent construction debris from entering the system and how often the filters will be changed, how the ductwork will be cleaned after use to ensure a clean system is turned over to the Owner and how the units are sized. Submit this procedure to the Mechanical Engineer for review. Follow National Air Duct Cleaners Association (NADCA) duct cleaning procedures and guidelines. Warranties for the house system, if new, to commence when the Owner moves in if house system is used as the means to maintain the climate within the building during construction. Include this warranty requirement in the original bid or proposal amount. Coordinate and provide any temporary power, controls, ductwork, piping, plumbing anchorage, miscellaneous steel and structural supports required to support the temporary system. Installation of the system to comply with all applicable codes and be acceptable to the Authority Having Jurisdiction (AHJ).

END OF SECTION

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SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Starters
2. Shaft Grounding
3. Motors

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. NEMA Premium Efficiency
2. Energy Policy Act (EPACT), latest applicable version(s) for minimum motor efficiencies.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.
2. Electrical components and materials to be UL and ETL listed/labeled as suitable for location and use.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Starters:

1. Cerus
2. Eaton Electrical
3. General Electric
4. Siemens
5. Schneider Electric/Square D
6. Or approved equivalent.

B. Shaft Grounding:

1. Shaft Grounding Inc.
2. Aegis SGR Bearing Protection Ring
3. Or approved equivalent.

C. Motors:

1. Lincoln Motor
2. Century Electric Motors (formerly A.O. Smith Electrical Products)
3. Baldor Electric
4. General Electric
5. Toshiba
6. Exception: Motors integral to equipment efficiency listing (EER, COP, etc.) per listing agency.
7. Or approved equivalent.

2.02 STARTERS

A. Single Phase Motors:

1. Manual across-the-line starting switch having toggle-operated switch pilot running light and built-in thermal overload device with heating element rated not more than 115 percent motor full load current indicated on name plate of motor to be protected. Surface mount starters. Provide NEMA-1 enclosure.
2. Overload relays to be melting alloy type with a replaceable control circuit module. Thermal units to be interchangeable. Starter to be non operative if thermal unit is removed.
3. Single-phase motors with automatic controls. Provide motor-rated relay with coils rated for control voltage.

B. Starters up to Size 8 to be suitable for the addition of a minimum of three external auxiliary contacts (normally open or normally closed). Contactor, coils, and relays to perform the control functions of the associated equipment and control sequence.

C. Three Phase Motors up to and Including 15 HP:

1. Provide enclosed type magnetic across-the-line starter with thermal overload and undervoltage protection.

2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.

3. Starters for 3-phase motors to have overload protection in each of the three legs, with external manual reset.

4. Unless indicated on Drawings or in Specifications, furnish motor starters with a neon pilot light. Neon lights are required for exhaust fan switches.

5. Equip starters with integral transformer and coil for control circuit. Coordinate coil voltage with control voltage.

2.03 SHAFT GROUNDING

A. Variable Speed Motor Shaft Grounding: Shaft grounding ring; solid ring type.

B. Provide shaft grounding assembly on motors controlled by variable frequency drive. Shaft grounding device to be in the form of brush that resides on the motor shaft. Brush assembly shall be capable of tolerating misalignment and maintaining rotating contact throughout the motors life.

C. Material: Material used in the grounding assembly shall be stable material commonly used within industry that is not believed to constitute a hazardous material under Occupational Safety & Health Administration (OSHA) regulations.

D. Brushes: Specifically developed carbon compounds of sustained performance with wear life expectancy of 3 years minimum.

E. Seals: Sealed type to keep contaminants from entering the shaft grounding system in wet or severe environment applications.

F. Shaft Grounding Assembly: For clean room air handling systems, use the type that contains the wear products within a special enclosure within the shaft grounding system.

2.04 MOTORS

A. Construction:

1. Open drip-proof type except where specifically noted otherwise.

2. Design for continuous operation in 40 degrees C environment.

3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

4. Built-in thermal overload protection or externally protected with separate over-load with low-voltage release or lock-out. Quick trip device on hermetically sealed motors.

5. Service Factor: 1.15 for poly-phase motors except 1.25 for motors associated with shaft pressurization system fans and 1.35 for single phase motors.

6. Efficiency: Provide NEMA Premium Efficiency motors.

7. Motors used in conjunction with variable speed drives: Variable torque type matched for the full operating range of the variable frequency drive. As a minimum, motors to have Class F insulation, winding insulation rated for 1000 Volts and insulated bearings to prevent high frequency ground path. Loads not-to-exceed 80 percent of nameplate rating

B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

C. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Coordinate conductor sizes with Division 26, Electrical. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.

2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.

D. Single Phase Power, Split Phase Motors:

1. Starting Torque: Less than 150 percent of full load torque.

2. Starting Current: Up to seven times full load current.

3. Breakdown Torque: Approximately 200 percent of full load torque.

4. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

5. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

E. Single Phase Power, Permanent-Split Capacitor Motors:

1. Starting Torque: Exceeding one fourth of full load torque.

2. Starting Current: Up to six times full load current.

3. Multiple Speed: Through tapped windings.

4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

F. Single Phase Power, Capacitor Start Motors:

1. Starting Torque: Three times full load torque.

2. Starting Current: Less than five times full load current.

3. Pull-up Torque: Up to 350 percent of full load torque.

4. Breakdown Torque: Approximately 250 percent of full load torque.

5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.

7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

G. Three Phase Power, Squirrel Cage Motors:

1. Starting Torque: Between 1 and 1-1/2 times full load torque.

2. Starting Current: Six times full load current.

3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

5. Insulation System: NEMA Class B or better. Use class F insulation when motors are controlled by a VFD.

6. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

7. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

8. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.

9. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

10. Sound Power Levels: To NEMA MG 1.

11. Weatherproof Epoxy Treated Motors: Epoxy coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.

12. Nominal Efficiency: Meet or exceed NEMA Premium Efficiency rating when tested in accordance with IEEE 112.

13. Nominal Power Factor: Minimum at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.

B. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.

C. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.

D. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency and latest EPACT.

E. Vertical in-line pump motors per NEMA MG1 vertical motor requirements.

F. Exception: Motors less than 250 watts, for intermittent service, motors furnished with equipment manufacturer's standard package equipment need not conform to these specifications.

G. Single phase motors for air compressors and pumps: Capacitor start type.

H. Motors located in exterior locations or wet air streams are to be of totally enclosed type.

I. Motors located in outdoor, wet/wash-down locations: Totally enclosed weatherproof epoxy-sealed type. Provide protective covering for electronically commutated motors located in outdoor or wet/wash-down locations.

J. Disconnects: Provided by Division 26, Electrical unless specified otherwise.

K. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

3.02 STARTER INSTALLATION

A. Install starters in accordance with manufacturer's instructions.

B. Coordinate disconnect requirements and location with Division 26, Electrical if not integral to starter. If starter is installed out of line of sight of motor, provide additional disconnect at motor per code.

C. Provide NEMA housing appropriate to installation location.

D. Provide supports and install securely, in neat and workmanlike manner, as specified in NECA 1.

E. Meet mounting height and accessible location requirements per local code.

F. Provide fuses for fusible switches.

G. Select and install overload heater elements in motor starters to match installed motor characteristics.

H. Single Phase 120 Volt Starter: If not furnished as single packaged controller/disconnect, provide contactors, relays, wiring and devices necessary to match sequence of operation for equipment.

3.03 SHAFT GROUNDING INSTALLATION

A. Shaft grounding assembly installation not to affect the motor manufacturer warranty. Where the severe environment conditions require application of the shaft grounding types that are screwed into the motor shaft, the installation of the shaft grounding system

performed either by the motor manufacturer or by the motor manufacturer authorized facility.

B. Bond the brush to the closest ground point using code sized green insulated stranded copper conductor per manufacturer instructions.

C. Test and verify the performance of the assembly to ensure that under no conditions the shaft exceeds 3 volts.

D. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

E. Check line voltage and phase and ensure agreement with nameplate.

F. Verify motor rotation.

3.04 MOTOR INSTALLATION

A. Electrical Service: Power wiring from source to motor termination under Division 26, Electrical.

B. Install in accordance with manufacturer's instructions. Coordinate with starter or variable speed controller with control sequence to provide necessary starter accessories.

C. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

D. Check line voltage and phase and ensure agreement with nameplate.

E. Verify motor rotation.

F. Field Quality Control:

1. Prepare for acceptance tests as follows:

   a. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.

   b. Test interlocks and control features for proper operation.

   c. Verify that current in each phase is within nameplate rating.

2. Testing: Perform the following field quality-control testing:

   a. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.

   b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

   a. Inspect field-assembled components, equipment installation, and piping and electrical connections for compliance with requirements.

   b. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

   c. Verify bearing lubrication.

   d. Verify proper motor rotation.

   e. Test Reports: Prepare a written report to record the following test procedures used:

1) Test results that comply with requirements.

2) Test results that do not comply with requirements and corrective action taken to achieve compliance.

G. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

H. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Hangers and Supports for HVAC Piping, Ductwork and Equipment
2. Wall and Floor Sleeves
3. Building Attachments
4. Flashing
5. Miscellaneous Metal and Materials

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. ASCE 7-16, Minimum Design Loads for Buildings and Other Structures.
2. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
3. Install ductwork and piping per SMACNA's requirements.
4. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Welding:

a. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".

2. Welding for Hangers:

a. Qualify procedures and personnel according to AWS D9.1, Sheet Metal Welding Code for duct joint and seam welding.

3. Engineering Responsibility:

a. Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, duct support equipment hangers/supports, support from floor structure, roof structure or from structure above, and seismic restraint by a qualified Structural Professional Engineer.

1) Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.

4. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.

5. Support systems to be supplied by a single manufacturer.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 PERFORMANCE REQUIREMENTS

A. Provide pipe, ductwork and equipment hangers and supports in accordance with the following:

1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor is responsible for their design.

2. Connections to structural framing not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.

B. Engineered Support Systems:

1. Support frames such as pipe racks or stanchions for piping, ductwork, and equipment which provide support from below.

2. Equipment, ductwork and piping support frame anchorage to supporting slab or structure.

C. Provide channel support systems, for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

E. Provide seismic restraint hangers and supports for piping, ductwork and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.

F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Hangers and Supports for HVAC Piping, Ductwork and Equipment:

1. Anvil International
2. B-Line Systems, Incorporated
3. Erico Company, Incorporated
4. Nelson-Olsen Incorporated
5. Rilco Manufacturing Company, Incorporated
6. Snappitz Thermal Pipe Shield Manufacturing
7. Unistrut Corporation

B. Wall and Floor Sleeves:

1. Thunderline Corporation “Link Seal”.
2. Or approved equivalent.

C. Building Attachments:

1. Anchor-It
2. Gunnebo Fastening Corporation
3. Hilti Corporation
4. ITW Ramset/Red Head
5. Masterset Fastening Systems, Incorporated

2.02 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

A. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.

B. Hanger Rod Couplings: Anvil Figure 136, B-Line Figure B3220, or approved equivalent; malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.

C. Channel Hanging System:

1. Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A1011 Grade 33, one side of channel to have a continuous slot within turned lips; framing nut with grooves and spring 1/2-inch size,

conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.

2. Concrete Inserts: Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.

D. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.

E. Pipe Hangers:

1. Pipe Rings for Hanger Rods:

a. Pipe Sizes 2-inches and Smaller: Adjustable swivel ring hanger, UL listed. Erico 100 or 101, Anvil Figures 69 or 104, or approved equivalent.

b. Pipe Sizes 2-1/2-inches and Larger: Clevis type hangers with adjustable nuts on rod, UL listed. Anvil figure 260, Erico 400, or approved equivalent.

c. Pipe hangers to have same finish as hanger rods.

F. Pipe Saddles and Shields:

1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.

2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).

G. Riser Clamps: Steel, UL listed. MSS Type 8. Erico 510 or 511. Copper coated; Erico 368.

H. Pipe Slides: Anvil, reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resists corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.

I. Pipe Guides:

1. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Contact with chilled water pipe not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.

2. Furnish and install guides approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.

J. Pipe Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.

K. Below Ground Pipe Supports:

1. Pipe Hangers All Sizes: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 304. MSS Type 1. Erico 406.

2. Rod: 5/8-inch stainless steel Type 18-8.

3. Eyebolt: Stainless steel Type 18-8.

4. Nuts and Washers: Stainless steel Type 18-8.

L. Thermal Hanger Shield Inserts:

1. 100-PSI (690-kPa) minimum compressive strength calcium silicate insulation, encased in sheet metal shield or polyisocyanurate rigid foam exceeding the load bearing weight of the pipe at the hanger point with a PVC vapor barrier.

2. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier or polyisocyanurate rigid foam with a PVC vapor barrier.

3. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate or polyisocyanurate rigid foam with a PVC vapor barrier.

4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.

5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.

6. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.

7. Thermal Hanger Shield Insulation Operating Temperature: Meet or exceed fluid temperature in pipe.

M. Freestanding Roof Supports: Polyethylene high-density UV resistant quick "pipe" block with foam pad.

2.03 WALL AND FLOOR SLEEVES

A. Below Grade or High Water Table Areas:

1. "Link-Seal" Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal.

2. Provide Type S unless otherwise noted.

B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.

C. Fabricated Accessories:

1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.

2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:

a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.

b. Sleeve Sizes 5-6-inches: 16 gauge.

c. Sleeve Sizes 7-inches and Larger: 14 gauge.

d. Fire-Rated Safing Material.

1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 pounds per cubic foot density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.

2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.04 BUILDING ATTACHMENTS

A. Beam Clamps:

1. MSS Type 19 and 23, wide throat, with retaining clip.

2. Universal Side Beam Clamp: MSS Type 20.

B. Powder-Actuated Drive Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

C. Anchor Bolts:

1. Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer. Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

2. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.

3. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.

4. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.

2.05 FLASHING

A. Steel Flashing: 26 gauge galvanized steel.

B. Safes: 8 mil thick neoprene.

C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

2.06 MISCELLANEOUS METAL AND MATERIALS

A. General:

1. Provide miscellaneous supports and metal items, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on drawings or otherwise not shown on drawings that are necessary for completion of the project. Contractor is responsible for their design.

2. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained

by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.

C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.

D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.

E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.

F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.

G. Provide hot dipped galvanized components for items exposed to weather. Cold galvanize field-welded joints and components. Use materials compatible with system being supported (i.e. aluminum for aluminum ductwork, stainless steel for stainless steel ductwork).

H. Use straps, threshold rods and wire with sizes required by SMACNA to support ductwork.

I. Grout:

1. ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.

2. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.

3. Properties: Nonstaining, noncorrosive, and non gaseous.

4. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.

B. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall", "2-Hour Fire/Smoke Barrier", and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.

C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate proper placement of inserts, anchors and other building structural attachments.

D. Equipment Clearances: Do not route ductwork, equipment, or piping through electrical rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-feet lateral clearance from all sides of electric switchgear panels. Do not route ductwork, equipment, or piping above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact ductwork, equipment or pipe routing to provide proper clearance with such items.

3.02 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

A. Hang rectangular sheet-metal ducts with a cross sectional area of less than 7 SF with galvanized strips of No. 16 USS gauge steel 1-inch wide, and larger ducts with steel angles and adjustable hanger rods similar to piping hangers. Support at a maximum of 8-feet on center.

B. Support horizontal ducts within 24-inches of each elbow and within 48-inches of each branch intersection.

C. Design hangers and supports to allow for expansion and contraction.

D. Provide aluminum supports for aluminum ductwork.

E. Provide stainless steel supports for stainless steel ductwork.

F. Support vertical ducts at maximum intervals of 16-feet and at each floor.

G. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

H. Install flexible ductwork per the more stringent of SMACNA HVAC Duct Construction Standards or the following:

1. Support horizontal duct runs at not more than 4 feet intervals.

2. Support vertical risers at not more than 6 feet intervals.

3. Limit sag between support hangers to 1/2-inch per foot of spacing support.

4. Supports shall be rigid and shall be not less than 1.5-inches wide at point of contact with the duct surface.

5. Duct bends shall be not less than 1.5 duct diameter bend radius.

I. Use double nuts and lock washers on threaded rod supports.

J. Floor supports in mechanical rooms to be elevated 1-inch above finish floor and void space filled with masonry grout.

K. Anchor ducts securely to building in such a manner as to prevent transmission of vibration to structure. Do not connect duct hanger straps directly to roof deck. Do not support ducts from other ducts, piping or equipment.

L. Attach strap hangers installed flush with end of sheet-metal duct run to duct with sheet-metal screws.

M. Construct exterior ductwork or ductwork which is otherwise exposed to weather watertight and slope 1/4-inch per foot to avoid standing water.

N. Exposed ductwork hung in clean areas such as sanitary areas, pharmaceutical areas, wash down areas or food process areas to be installed using double end, food grade trapeze hanger rods suitable for use with food grade strut.

O. Channel Support System Installation:

1. Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.

2. Field assemble and install according to manufacturer's written instructions.

P. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

Q. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

R. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

S. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping, ductwork and equipment to proper level and elevations.

T. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

U. Horizontal Piping Hangers and Supports; Horizontal and Vertical Piping, and Hanger Rod Attachments:

1. Factory fabricated horizontal piping hangers and supports complying with MSS SP-58, to suit piping systems and in accordance with manufacturer's published product information.

2. Use only one type by one manufacturer for each piping service.

3. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping.

4. Pipe support spacing (pipe supported in ceiling or floor-supported) to meet latest applicable Code and manufacturer's requirements.

5. Provide copper-plated hangers and supports for uninsulated copper piping systems.

V. Plumber's Tape not permitted as pipe hangers or pipe straps.

W. Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.

X. Pipe Ring Diameters:

1. Uninsulated and Insulated Pipe, Except Where Oversized Pipe Rings are Specified: Ring inner diameter to suit pipe outer diameter.

2. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.

Y. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.

Z. Pipe Support Brackets: Support pipe with pipe slides.

AA. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.

BB. Pipe Guides:

1. Install on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Contact with chilled water pipe does not permit heat to be transferred in sufficient quantity to cause condensation on any surface.

2. Install approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.

CC. Heavy-Duty Steel Trapeze Installation:

1. Arrange for grouping of parallel runs of horizontal piping and support together on field fabricated, heavy-duty trapezes.

2. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

3. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

DD. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers. Maximum spacings: MSS SP-58.

EE. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe.

FF. Do not support piping from other piping.

GG. Fire protection piping will be supported independently of other piping.

HH. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.

II. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.

JJ. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating Below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

2. Do not exceed pipe stress limits according to ASME B31.9.

3. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

4. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields to span arc of 180 degrees.

5. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.

6. Shield Dimensions for Pipe, not less than the following:

   a. NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inch thick.

7. Pipes NPS 8 (DN200) and Larger: Include wood inserts.

   a. Insert Material: Length at least as long as protective shield.

8. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

KK. Pipe Anchors: Provide anchors to fasten piping which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.

LL. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor walls, and through equipment room walls and floors.

3.03 WALL AND FLOOR SLEEVES

A. "Link-Seal" Pipe Sleeves: Install at floor/below grade piping penetrations. Provide manufacturer's sleeve appropriate to seal type for pre-cast penetrations.

B. Fabricated Pipe Sleeves:

1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirements, and by waterproofing requirements.

2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.

3. Provide temporary support of sleeves during placement in concrete and other work around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.

4. Seal each end airtight with a resilient nonhardening sealer, UL listed, fire rated ASTM 814.

C. Installation of metallic or plastic piping penetrations through non fire-rated walls and partitions and through smoke-rated walls and partitions:

1. Install fabricated pipe sleeve.

2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.

3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814.

D. Piping Penetrations Through Fire-Rated (One to Three Hour) Assemblies:

1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and manufacturer's recommendation.

2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.

3.04 BUILDING ATTACHMENTS

A. Factory fabricated attachments complying with MSS SP-58, selected to suit building substructure conditions and in accordance manufacturer's published product information.

B. Select size of building attachments to suit hanger rods.

C. Space attachments within maximum piping span length indicated in MSS SP-58.

D. Install building attachments within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.

E. Attachment to Wood Structure: Anvil side beam bracket Figure 202 for attachment to wooden beam or approved attachment for a wood structure.

F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Install concrete inserts before concrete is placed; fasten inserts to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.

H. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Test powder-actuated insert attachments with a minimum load of 100 pounds.

I. Do not use powder-actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4-inches thick.

J. Bolting: Provide bored, drilled or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched or hand sawn holes will not be accepted.

K. Anchor Bolts:

1. Install anchor bolts for mechanical equipment, piping and ductwork as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment, piping and ductwork are hung.

2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.

3.05 FLASHING

A. Flash and counterflash where piping, ductwork and equipment passes through weather or waterproofed walls, floors, and roofs.

B. Provide 12-inch minimum height curbs for roof-mounted mechanical equipment. Flash and counter flash with galvanized steel, soldered and waterproofed.

3.06 MISCELLANEOUS METAL AND MATERIALS

A. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates, and similar devices. Hot dipped galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.

B. Finishes:

1. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas in primer with same material, before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.

2. Metal in Contact with Concrete, Masonry and Other Dissimilar Materials: Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.

3. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.

C. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction;

including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.

E. Cutting, Fitting and Placement: Perform cutting, drilling and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items, which are to be built into concrete masonry or similar construction.

F. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

G. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.

H. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.

I. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

J. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.

K. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

L. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

M. Provide galvanized components for items exposed to weather.

3.07 FIRE RATED SUPPORTS

A. Provide fire rated support as required by Codes.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Vibration Isolation
2. Seismic Restraint Devices
3. Factory Finishes
4. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork

B. General:

1. Vibration isolation for mechanical ductwork, piping and equipment.
2. Seismic restraint for mechanical ductwork, piping and equipment.
3. Seismic Certification for equipment, hangers and systems.
4. Special inspections for systems.

C. Scope of Work:

1. Vibration isolation and seismic restraint of new equipment and systems within project boundary defined in architectural drawings.
2. Vibration isolation and seismic restraint of new equipment and systems in existing buildings to points of connection with existing systems.
3. Provide supplementary structural steel for seismic restraint systems. No hanging from roof deck is permitted on this project, unless specifically allowed by Structural Engineer of Record in writing prior to bid.

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Vibration Isolation:

a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.

b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:

1) Fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads.

2) Equipment mounting holes.

3) Dimensions.

4) Size and location of concrete and steel bases and curbs.

5) Isolation selected for each support point.

6) Details of mounting brackets for isolator.

7) Weight distribution for each isolator.

8) Details of seismic snubbers.

9) Code number assigned to each isolator.

c. Design calculations: Provide calculations for selecting vibration isolators and for designing vibration isolation bases.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Seismic Restraint:

a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section. Shop drawings to be stamped by a professional Structural Engineer licensed in State of Oregon.

b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details and indicate quantity, diameter and depth of penetration of anchors. Calculations certified by professional Structural Engineer licensed in State of Oregon.

4. Seismic Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter and depth of penetration of anchors.

5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y and z planes.

6. Welding certificates.

7. Equipment Certification: Provide seismic certification for equipment as noted in Seismic Design Summary or schedules on Drawings.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Vibration Isolation:

a. Except for packaged equipment with integral isolators, single manufacturer selects and furnishes isolation required.

b. Deflections indicated on drawings are minimum actual static deflections for specific equipment supported.

c. Isolator Stability:

1) Size springs of sufficient diameter to maintain stability of equipment being supported. Spring diameters not less than 0.8 of compressed height at rated load.

2) Springs have minimum additional travel to solid equal to 50 percent of rated defection.

3) Springs support 200 percent of rated load, fully compressed, without deformation or failure.

d. Maximum Allowable Vibration Levels: Peak vibration velocities not exceed 0.08 in/sec. Correct equipment operating at vibration velocities that exceed this criteria.

2. Seismic Restraint:

a. Code and Standard Requirements:

1) Seismic restraint of equipment, piping and ductwork to be in accordance with latest enacted version of OSSC Chapter 16.

b. Confirm Seismic Control requirements in Division 01, General Requirements and Structural documents.

c. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure be designed to resist total design seismic force prescribed in local building code:

1) Floor- or roof-mounted equipment weighing 400 pounds or greater.

2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.

3) In-line duct devices connected to ductwork weighing 75 pounds or greater.

4) Housekeeping slabs: provide reinforcement and anchorage to building structure.

d. Where required, seismic sway bracing of suspended duct and piping meet following:

1) Pipe and duct runs requiring seismic bracing have minimum of two traverse braces and one longitudinal brace. Longitudinal (or traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.

2) Seismic bracing may not pass through seismic separation joint. Pipe or duct runs that pass through seismic separation joint must be restrained within 5-feet of both sides of separation.

3) Seismic brace assembly spacing not to exceed 40-feet transverse and 80-feet longitudinal.

e. Seismic restraints may be omitted from suspended piping and duct if following conditions are satisfied:

1) For piping or ducts supported by rod hangers 12-inches or less in length from top of duct to bottom of structural support. Top connections to structure have swivel joints, eye bolts, or vibration isolation hangers for entire length of system run.

2) Lateral motion of system will not cause damaging impact with surrounding systems or cause loss of system vertical support.

3) System must be welded steel pipe, brazed copper pipe, sheet metal duct or similar ductile material with ductile connections.

C. Seismic restraints, including anchors to building structure, be designed by registered professional Structural Engineer licensed in State of Oregon. Design includes:

1. Number, size, capacity and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both unit to curb and curb to structure.

2. Number, size, capacity and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations and test data verifying horizontal and vertical ratings of seismic restraint devices.

3. Number, size, capacity and location of braces and anchors for suspended piping and ductwork on as-built plan drawings.

4. Maximum seismic loads to be indicated on drawings at each brace location. Drawings bear stamp and signature of registered professional Structural Engineer who designed layout of braces.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Vibration Isolation:

1. The VMC Group

2. B-Line Systems, Inc.

3. Kinetics Noise Control, Inc.

4. Mason Industries, Inc.

5. M.W. Saussé - Vibrex

6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.

B. Seismic Restraint Devices:

1. The VMC Group

2. B-Line Systems, Inc.

3. Kinetics Noise Control, Inc.

4. Mason Industries, Inc.

5. M.W. Saussé - Vibrex

6. California Dynamics Corporation

7. Cooper B-Line Tolco

8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.

9. Hilti, Inc.

C. Factory Finishes:

1. Kynar 500 Fluoropolymer Coating

2. Or approved equivalent.

D. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork:

1. The VMC Group

2. Kinetics Noise Control, Inc.

3. Mason Industries, Inc.

4. Hilti, Inc.

5. Cooper B-Line, Inc.

6. California Dynamics Corporation

7. Unistrut

8. ISAT, Inc.

9. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.

2.02 VIBRATION ISOLATION

A. Type 1 - Neoprene Pad: Natural rubber waffle pads, arranged in single or multiple layers, 3/4-inch thick per layer with pattern repeating on 1/2-inch centers; 50 durometer hardness; maximum loading 60 PSI. Minimum 1/4-inch thick steel load distribution plate and 1/16-inch shim plates between layers, factory cut to sizes matching requirements of

supported equipment. Molded bridge with neoprene anchor bolt bushing and flat washer face to prevent metal to metal contact. Number of layers required for equipment scheduled. Mason Type: Super WMH.

B. Type 4a - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops (out of contact during normal operation) to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Restraining bolts have large rubber grommets to provide cushioning in vertical and horizontal directions. A minimum clearance of 3/8-inch maintained around restraining bolts so as not to interfere with spring action.

2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.

3. Minimum Additional Travel: 50 percent of required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.

7. Mason Type: SLR.

C. Type 5c - Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.

3. Minimum Additional Travel: 50 percent of required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

8. Mason Type: RW30.

D. Type FC-1, Flexible duct connectors. See Specification Section 23 33 00 Air Duct Accessories.

2.03 SEISMIC RESTRAINT DEVICES

A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.

B. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts and replaceable resilient isolation washers and bushings. Snubber load rating to match equipment size. Mason Type: Z-1011 or Z-1225.

1. Anchor bolts for attaching to concrete be seismic-rated, drill-in and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.

C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Mason Type: SCB.

D. Anchor Bolts: Seismic-rated, drill-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.04 FACTORY FINISHES

A. Provide manufacturer's standard prime-coat finish ready for field painting. Units mounted outdoors exposed to weather: Epoxy powder coated, with 1000 hour salt spray rating per ASTM B-117. For high levels of corrosion protection utilize:

1. Conform to AAMA 605.2.

2. Apply coating following cleaning and pretreatment.

3. Cleaning: AA-C12C42R1X.

4. Dry system before final finish application.

5. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.

B. Finish:

1. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment before shipping.

2. Powder coating on springs and housings.

3. Hardware be electrogalvanized. Hot-dip galvanize metal components for exterior use.

4. Baked enamel for metal components on isolators for interior use.

5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.05 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

A. General Requirements for Restraint Components: Rated strengths, features and applications to be as defined in reports by agency acceptable to authorities having jurisdiction.

B. Structural Safety Factor: Allowable strength in tension, shear and pullout force of components be at least four times maximum seismic forces to which they will be subjected.

C. Anchor bolts for attaching to concrete to be seismic-rated, drill-in and stud-wedge or female-wedge type.

D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

E. Maximum 1/4-inch air gap and minimum 1/4-inch thick resilient cushion.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Set floor-mounted equipment with steel base rails on minimum 4-inch-high concrete housekeeping pads. Extend pad minimum 6-inches beyond footprint of equipment in each direction, but not less than twice the embedment depth of concrete anchors.

B. Provide mounts for equipment installed outdoors for wind loads of 30 lbs. psf applied to any exposed surface of isolated equipment.

C. Do not install equipment or pipe which makes rigid contact with building slabs, beams, studs, walls, etc.

D. Anchor baseplate to floor or structure. Provide rubber grommets and washers to isolate bolt from base plate. Under no circumstances is isolation efficiency to be destroyed when bolting isolators to floor.

E. Building Penetrations: Isolate water piping and ductwork penetrating wall, ceilings, floors or shafts from structure by piping isolator or by 3/8-inch thick foamed rubber insulation. Install units flush with finished structure face, using one for each side as required. Cut units to length if longer than structure thickness. Caulk around pipe or duct at equipment room wall.

F. Provide roof curbs, equipment supports and roof penetrations. Work to maintain roof warranty. Coordinate location, size, structural connections/requirements and flashing prior to installation.

G. Vibration isolators must not cause change of position of equipment or piping which would stress piping connections or misalignment shafts or bearings. Isolated equipment is to be level and in proper alignment with connecting ducts and pipes.

H. Pipe Hangers in Equipment Rooms: Support water and gas piping connected to rotating equipment within equipment rooms on spring and neoprene hangers. The first three hangers from a piece of vibrating equipment are to have a minimum of 1/2 static deflection of equipment isolators. Other isolators should have a minimum of 1/4 static deflection of equipment isolators.

I. Examination:

1. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements, installation tolerances and other conditions affecting performance.

2. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

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

J. Testing: Perform following field quality-control testing:

1. Isolator seismic-restraint clearance.

2. Isolator deflection.

3. Snubber minimum clearances.

K. Adjusting:

1. Adjust snubbers according to manufacturer's written recommendations.

2. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

L. Cleaning: After completing equipment installation, inspect vibration isolation and seismic-control devices. Remove paint splatters and other spots, dirt and debris.

M. Demonstration: Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain air-mounting systems. Reference Division 01, General Requirements.

3.02 VIBRATION ISOLATION

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Vibration isolators must be installed in strict accordance with manufacturer's written instructions and certified submittal data.

D. Install isolation as indicated on drawings by type and location and where indicated below.

E. Equipment Vibration Isolation Schedule:

Equipment	Size	Vibration Isolator Type	Minimum Deflection (in)
Fan-coils	All	Type 5C, FC-1	0.75
Condensing Units	0 to 4.5 tons	Type 1	0.3
Condensing Units	5+ tons	Type 4A	2.5
Axial, Cabinet, Centrifugal Inline Fans	0 to 23.5-inch diameter	Type 5C, FC-1	0.75
Axial, Cabinet, Centrifugal Inline Fans	24-inch+ diameter	Type 5C, FC-1	1.5

F. Isolation Mounts:

1. Install minimum of four seismic snubbers on isolated equipment. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts.

3. Provide flexible piping connection and flexible ductwork connection to equipment with isolation mounts or bases.

G. Isolating Hangers:

1. Support piping and ductwork connected to isolated equipment within equipment rooms on isolating hangers as scheduled on drawings. Unless otherwise noted, first three hangers from isolated equipment to have a minimum of 1/2 static deflection of equipment isolators. Other isolating hangers to have a minimum of 1/4 static deflection of equipment isolators.

2. Position isolating hanger elements as high as possible in hanger rod assembly, but not in contact with building structure. Install hangers so that hanger housing may rotate full 360 degrees about rod axis without contacting any object.

3. Unless otherwise noted, air supply units with internally isolated fans do not require isolating hangers for connecting pipes and ductwork.

4. Where parallel running pipes are hung together on an isolated trapeze, provide isolator deflections for largest determined by provisions for pipe isolation. Do not mix isolated and non-isolated pipes in same trapeze.

5. Install limit stops so they are out of contact during normal operation.

H. Adjusting:

1. Adjust isolators after piping systems have been filled and equipment is at operating weight.

2. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

3.03 SEISMIC RESTRAINT DEVICES

A. Reference 3.01, General Installation Requirements.

B. Install in strict accordance with manufacturer's written instructions and certified submittal data.

C. Install and adjust seismic restraints so equipment, piping and ductwork supports are not degraded by restraints.

D. Restraints must not short circuit vibration isolation systems or transmit objectionable vibration or noise.

E. Install restraining cables at each trapeze, individual pipe hanger and hanging vibration isolated equipment. Provide restraining cables in each of the four directions of

movement. Install restraining cables no less than 45 Degrees from vertical. At trapeze anchor locations, shackle piping to trapeze. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.

F. Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers. At trapeze anchor locations, shackle piping to trapeze. Requirements apply equally to hanging equipment. Do not weld angles to rods.

3.04 FACTORY FINISHES

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Finishes to be factory-applied. No field patching or holidays allowed.

3.05 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

A. Reference 3.01, General Installation Requirements.

B. Install per manufacturer's instructions and recommendations.

C. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

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SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Plastic Nameplates
2. Plastic Pipe Markers

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Schedules:

a. Submit valve schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.

2. Submit schedule of identification type, including material, for each class of tagged item.

3. Submit locations at which Valve Schedules will be installed.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.

2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 PLASTIC NAMEPLATES

A. Manufacturers:

1. Brady Corporation
2. Brimar
3. Champion America
4. Craftmark
5. Seton

B. Description: Engraving stock melamine plastic laminate in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Provide 1/8-inch thick material.

1. Letter Color: White.
2. Letter Height: 1/2-inch.
3. Background Color: Black.
4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.

2.02 PLASTIC PIPE MARKERS

A. Manufacturers:

1. Brady Corporation
2. Brimar
3. Champion America
4. Craftmark
5. Seton

B. Color: Conform to ASME A13.1 and ANSI Z535.1.

C. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

E. Lettering:

1. 3/4-inch to 1-1/4-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 1/2-inch high letters.

2. 1-1/2-inch to 2-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 3/4-inch high letters.

3. 2-1/2-inch to 6-inch Outside Diameter of Insulation or Pipe: 12-inch long color field, 1-1/4-inch high letters.

4. 8-inch to 10-inch Outside Diameter of Insulation or Pipe: 24-inch long color field, 2-1/2-inch high letters.

5. Over 10-inch Outside Diameter of Insulation or Pipe: 32-inch long color field, 3-1/2-inch high letters.

PART 3 - EXECUTION

3.01 GENERAL - INSTALLATION

A. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates riveted to equipment body.

B. Identify piping, concealed or exposed, with plastic pipe markers.

C. Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

D. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

E. Degrease and clean surfaces to receive adhesive for identification materials.

F. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

G. Install all products in accordance with manufacturer's instructions.

H. Manual Balancing Dampers: Provide 12-inch long orange marker ribbon to end of balancing damper handle.

3.02 PLASTIC NAMEPLATES

A. Install plastic nameplates with corrosive-resistant mechanical fasteners.

B. Identify control panels and major control components outside panels with plastic nameplates riveted to equipment body.

C. Identify thermostats with nameplates.

3.03 PLASTIC PIPE MARKERS

A. Install plastic pipe markers complete around pipe in accordance with manufacturer's instructions.

B. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20-feet (reduced to 10-feet in congested areas and mechanical equipment rooms) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction. Locate near branches, valves, control devices, equipment connections, access doors, floor/wall penetrations.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. General Requirements and Procedures
2. Fundamental Air Systems Balancing Procedures
3. Constant Volume Air Systems Balancing Procedures
4. Final Reports:
    a. Report Requirements
    b. General Report Data
    c. System Diagrams
    d. Air Handling Units
    e. Fans
    f. Duct Traverses
    g. Diffusers/Registers/Grilles
    h. Instrument Calibration
5. Additional Tests

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Quality-Assurance Submittals: Submit two copies of evidence that the Testing, Adjusting, and Balancing (TAB) Agent and Project's TAB team members meet the qualifications specified in the "Quality Assurance" Article below.
2. Pre-Construction Phase Report:
    a. Provide a pre-construction phase TAB Plan at least two weeks prior to the commencement of TAB work. This report is to include:

1) A complete set of report forms intended for use on the Project, with data filled in except for the field readings. Forms to be Project-specific.

2) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.

3) Identification of the type, manufacturer, and model of the actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications to be included.

4) A narrative of Project-specific and/or non-standard TAB procedures to be used, and the equipment or systems to which they apply.

3. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit two copies of the Contract Documents review report as specified in Part 3 of this Section.

4. Strategies and Procedures Plan: Submit two copies of the TAB strategies and step-by-step procedures as specified in Part 3 of this Section. Include a complete set of report forms intended for use on this Project.

5. Specify reports required because of editing procedures in Part 3 of this Section.

6. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the TAB Agent.

7. Sample Report Forms: Submit two sets of sample TAB report forms.

8. Test Instrument Calibration: Submit proof of calibration within the last 6 months.

9. Final Report.

10. Provide additional submittals to commissioning authority as dictated in Commissioning Specifications.

1.05 QUALITY ASSURANCE

A. Quality Assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Acceptable TAB Agencies:

a. Oregon:

1) Air Introduction and Regulations Inc.

2) Accurate Air Balance, Inc.

3) Neudorfer Engineers

4) Northwest Engineering Services

5) Air Balancing Specialty Inc.

6) Precision Test & Balance, Inc.

7) Testcomm

8) American Commissioning and LEED Consultants, Inc.

2. Balance Firm Qualifications:

    a. General:

        1) Procure services of independent TAB agency to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum experience: 5 years.

        2) Provide proof of testing agency having successfully completed at least five projects of similar size and scope.

    b. Testing and Balancing firm is certified by NEBB or AABC and has a NEBB Certified Professional (CP) or a AABC Test and Balancer Engineer (TBE) on staff.

    c. Industry Standards: Testing and Balancing will conform to NEBB or AABC, and American National Standards Institute (ANSI) as follows:

        1) NEBB: Comply with Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

        2) AABC: Comply with National Standards for Total System Balance.

        3) ANSI:

            a) S1.4 Specifications for sound level meters.

            b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.

            c) ANSI S1.13 Methods for the Measurement of Sound Pressure Levels.

    d. Test Observation: If requested, conduct tests in the presence of the Commissioning Authority, AHJ, Architect or the Architect's representative.

3. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).

4. Owner Witness: Perform tests in the presence of the Commissioning Authority, Architect, Architect's Representative, or Owner's representative.

5. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.

6. Simultaneous Testing: Test observations by the AHJ, the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.

7. Do not perform TAB work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.

8. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.

9. TAB Conference: Meet with the Commissioning Authority, Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives,

HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.

a. Agenda Items: Include at least the following:

1) Submittal distribution requirements.

2) Contract Documents examination report.

3) TAB plan.

4) Work schedule and Project site access requirements.

5) Coordination and cooperation of trades and subcontractors.

6) Coordination of documentation and communication flow.

10. Certification of TAB Reports: This certification includes the following:

a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.

b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

11. TAB Reports: Use standard forms from NEBB or AABC.

12. Instrumentation Type, Quantity, and Accuracy: As described in NEBB or AABC.

13. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of outlet, coil, or device listed in the final TAB report.

2. Guarantee: Meet the requirements of the following programs:

a. Provide a guarantee on NEBB or AABC forms stating that the agency will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:

1) The certified Agent has tested, adjusted, and balanced systems according to the Contract Documents.

2) Systems are balanced to optimum performance capabilities within design and installation limits.

1.07 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.

F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. TAB: Testing, Adjusting, and Balancing.

K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

L. Test: A procedure to determine quantitative performance of a system or equipment.

M. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.

N. AABC: Associated Air Balance Council.

O. NEBB: National Environmental Balancing Bureau.

P. AMCA: Air Movement and Control Association.

Q. CTI: Cooling Tower Institute.

R. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.08 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.

C. Witness leakage and pressure tests carried out by Section 23 31 00, HVAC Ducts and Casings.

D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS AND PROCEDURES

A. Project Conditions:

1. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.

B. General Requirements:

1. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.

2. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for TAB are clean and free from debris, dirt and discarded building materials.

3. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner's operations.

C. Examination:

1. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

a. Contract Documents are defined in the General and Supplementary Conditions of the Contract.

b. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

2. Examine approved submittal data of HVAC systems and equipment.

3. Examine Project record documents described in Division 01, General Requirements.

4. Examine Architect's and Engineer's design data, including Basis of Design, HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

5. Examine equipment performance data, including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at

the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

6. Coordinate requirements in system and equipment with this Section.

7. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

8. Examine system and equipment test reports.

9. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

10. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

11. Examine equipment for installation and for properly operating safety interlocks and controls.

12. Report deficiencies discovered before and during performance of TAB procedures.

D. Preparation:

1. Prepare a TAB plan that includes strategies and step-by-step procedures.

2. Complete system readiness checks and prepare system readiness reports. Verify the following:

   a. Permanent electrical power wiring is complete.

   b. Hydronic systems are filled, clean, and free of air.

   c. Automatic temperature-control systems are operational.

   d. Equipment and duct access doors are securely closed.

   e. Balance, smoke, and fire dampers are open.

   f. Isolating and balancing valves are open and control valves are operational.

   g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

   h. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.

3. Hold a pre-balancing meeting at least one week prior to starting TAB work.

   a. Attendance is required by installers whose work will be tested, adjusted, or balanced.

4. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.

E. General TAB Procedures:

1. Perform TAB procedures on each system according to the procedures contained in NEBB or AABC and this Section.

2. Coordinate location of test probes prior to start of TAB procedures and make test probes available for Owner's tests after start of occupancy. Where required, cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

3. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

F. Adjustment Tolerances:

1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.

2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3. Hydronic Systems: Adjust to within plus or minus 10 percent of design at coils and plus or minus 5 percent at system pumps and equipment.

4. Adjust supply, return, and exhaust air quantities to maintain pressurization in spaces indicated on Drawings. Note and document room-to-room pressurization and maintain these relationships. Adjust pressure controlled spaces to within plus or minus 0.01 in WC.

G. Recording and Adjusting:

1. Field Logs: Maintain written logs including:

   a. Running log of events and issues.

   b. Discrepancies, deficient or uncompleted work by others.

   c. Contract interpretation requests.

   d. Lists of completed tests.

2. Ensure recorded data represents actual measured or observed conditions.

3. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

4. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.

5. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

6. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

7. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner's Authorized Representative, or Commissioning Agent.

3.02 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES

A. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

B. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.

C. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

D. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.

E. Prepare schematic diagrams of systems' "as-built" duct layouts.

F. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

G. Check the airflow patterns from the outside-air louvers and dampers and the return-air and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

I. Verify that motor starters are equipped with thermal protection, sized for the connected load.

J. Check dampers for proper position to achieve desired airflow path.

K. Check for airflow blockages.

L. Check that condensate drains are installed, trapped and primed and routed to drain.

M. Check for readily observable leaks in air-handling unit components and ductwork.

N. Use sheaves and pulleys to adjust the speed of belt drive fans to achieve design flow with motors running at 60 Hertz unless noted otherwise.

3.03 CONSTANT VOLUME AIR SYSTEMS BALANCING PROCEDURES

A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer. Adjust fans to deliver design airflow at the lowest possible speed.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet or through the flexible connection.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each air-handling unit component under final balanced condition.

3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Recommend corrective action to align design and actual conditions.

4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

5. Do not make fan-speed adjustments that result in motor loading greater than full load amps. Do not increase fan speed beyond fan class rating. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.

6. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.

7. Calibrate airflow measuring stations.

3.04 FINAL REPORTS

A. Report Requirements:

1. General:

a. Computer generated in PDF format and tabulated, divided, and bookmarked into sections by tested and balanced systems.

b. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.

1) Include a list of the instruments used for procedures, along with proof of calibration.

c. Final Report Contents: In addition to the certified field report data, include the following:

1) Pump curves

2) Fan Curves

3) Manufacturers Test Data

4) Field test reports prepared by system and equipment installers

5) Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data

B. General Report Data:

1. In addition to the form titles and entries, include the following data in the final report, as applicable:

a. Title Page

b. Name and Address of TAB Agent

c. Project Name

d. Project Location

e. Architect's Name and Address

f. Engineer's Name and Address

g. Contractor's Name and Address

h. Report Date

i. Signature of TAB Agent who Certifies the Report

j. Summary of Contents, Including the Following:

1) Design versus Final Performance

2) Notable Characteristics of Systems

3) Description of System Operation Sequence if it varies from the Contract Documents

k. Nomenclature Sheets for Each Item of Equipment

l. Data for Terminal Units, including Manufacturer, Type Size, and Fittings

m. Notes to explain why certain final data in the body of reports vary from design values.

n. Test Conditions for Fans and Pump Performance Forms, Including the Following:

1) Settings for Outside-, Return-, and Exhaust-air Dampers

2) Conditions of Filters

3) Cooling Coil, Wet- and Dry-bulb Conditions

4) Face and Bypass Damper Settings at Coils

5) Fan Drive Settings, including Settings and Percentage of Maximum Pitch Diameter

6) Inlet Vane Settings for Variable-Air-Volume Systems

7) Settings for Supply-air, Static-pressure Controller

8) Other System Operating Conditions that affect Performance

C. System Diagrams:

1. Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:

a. Quantities of Outside, Supply, Return, and Exhaust Airflows

b. Water and Steam Flow Rates

c. Duct, Outlet, and Inlet Sizes

d. Pipe and Valve Sizes and Locations

e. Terminal Units

f. Balancing Stations

D. Air Handling Units:

1. For air-handling units, split systems, fan coils, pumps, and evaporator units with coils, include the following:

a. Unit Data: Include the following:

1) Unit Identification

2) Location

3) Make and Type

4) Model Number and Unit Size

5) Manufacturer's Serial Number

6) Unit Arrangement and Class

7) Discharge Arrangement

8) Sheave Make, Size in inches, and Bore

9) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches

10) Number of Belts, Make, and Size

11) Number of Filters, Type, and Size

b. Motor Data: Include the following:

1) Make and Frame Type and Size

2) Horsepower and rpm

3) Volts, Phase, and Hertz

4) Full-load Amperage and Service Factor

5) Sheave Make, Size in Inches, and Bore

6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches

c. Test Data: Include design and actual values for the following:

1) Total Airflow Rate in cfm (L/s)

2) Total System Static Pressure in Inches wg (Pa)

3) Fan rpm

4) Discharge Static Pressure in Inches wg (Pa)

5) Filter Static-pressure Differential in Inches wg (Pa)

6) Preheat Coil Static-pressure Differential in Inches wg (Pa)

7) Cooling Coil Static-pressure Differential in Inches wg (Pa)

8) Heating Coil Static-pressure Differential in Inches wg (Pa)

9) Outside Airflow in cfm (L/s)

10) Return Airflow in cfm (L/s)

11) Outside-air Damper Position

12) Return-air Damper Position

13) Vortex Damper Position

E. Fans:

1. Fan Test Reports: For supply, return, and exhaust fans, include the following:

a. Fan Data: Include the following:

1) System Identification
2) Location
3) Make and Type
4) Model Number and Size
5) Manufacturer's Serial Number
6) Arrangement and Class
7) Sheave Make, Size in Inches, and Bore
8) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches

b. Motor Data: Include the following:

1) Make and Frame Type and Size
2) Horsepower and rpm
3) Volts, Phase, and Hertz
4) Full-load Amperage and Service Factor
5) Sheave Make, Size in Inches, and Bore
6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
7) Number of Belts, Make, and Size

c. Test Data: Include design and actual values for the following:

1) Total Airflow Rate in cfm
2) Total System Static Pressure in Inches wg
3) Fan rpm
4) Discharge Static Pressure in Inches wg
5) Suction Static Pressure in Inches wg

F. Duct Traverses:

1. Include a diagram with a grid representing the duct cross-section and record the following:

a. Report Data: Include the following:

1) System and Air-handling Unit Number
2) Location and Zone
3) Duct Static Pressure in Inches wg
4) Duct Size in Inches
5) Duct Area in SF
6) Design Airflow Rate in cfm
7) Design Velocity in fpm

8) Actual Airflow Rate in cfm
9) Actual Average Velocity in fpm

G. Diffusers/Registers/Grilles:

1. For diffusers, registers and grilles, include the following:

a. Unit Data: Include the following:

1) System and Air-handling Unit Identification
2) Location and Zone
3) Test Apparatus Used
4) Area Served
5) Air-terminal-device Make
6) Air-terminal-device Number from System Diagram
7) Air-terminal-device Type and Model Number
8) Air-terminal-device Size
9) Air-terminal-device Effective Area in SF

b. Test Data: Include design and actual values for the following:

1) Airflow Rate in cfm
2) Air Velocity in fpm
3) Final Airflow Rate in cfm
4) Final Velocity in fpm
5) Space Temperature in Degrees F

H. Instrument Calibration:

1. For instrument calibration, include the following:

a. Report Data: Include the following:

1) Instrument Type and Make
2) Serial Number
3) Application
4) Dates of Use

b. Dates of Calibration

3.05 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Type A, Flexible Glass Wool Blanket
2. Type B, Duct Liner
3. Type 2, Flexible Elastomeric Pipe Insulation
4. Accessories
5. Duct Insulation Accessories
6. Duct Insulation Compounds

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Installer qualifications.
2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
3. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
5. Submit manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.

2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.

3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.

4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 FIRE HAZARD CLASSIFICATION

A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.

B. Test pipe insulation in accordance with the requirements of current edition of UL "Pipe and Equipment Coverings R5583 400 8.15".

C. Test duct insulation in accordance with current edition of ASTM E84, UL 723, NFPA 255, NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.01 TYPE A, FLEXIBLE GLASS WOOL BLANKET

A. Acceptable Manufacturers:

1. Certainteed

2. Johns Manville

3. Knauf

4. Owens-Corning

B. ASTM C553, Type 1, Class B-2; flexible blanket.

C. 'K' Value: 0.27 BTU*in/(hr*sf*F) at 75 degrees F installed, maximum service temperature: 250 degrees F.

D. Density: 0.75 pounds per cubic foot.

E. DBDE-free. UL/E validated to be formaldehyde-free.

F. Vapor Barrier Jacket: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

2.02 TYPE B, DUCT LINER

A. Acceptable Manufacturers:

1. Certainteed
2. Johns Manville
3. Knauf
4. Owens-Corning

B. ASTM C1071; flexible blanket.

C. 'K' Value: ASTM C518, 0.25 BTU*in/(hr*sf*F) at 75 degrees F, maximum service temperature: 250 degrees F.

D. Noise Reduction Coefficient: 0.65 or higher based on ASTM C 423 "Type A mounting."

E. Maximum Velocity on Mat or Coated Air Side: 5,000 FPM.

F. Adhesive: UL listed waterproof type.

G. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.

H. Erosion-Resistant Surfaces: UL 181.

I. ASTM G21 and ASTM G22 Microbial Growth Resistance.

J. UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-“GREENGUARD Certification Program Method for Measuring Microbial Resistance”. DBDE-free. UL/E validated to be formaldehyde-free.

2.03 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Acceptable Manufacturers:

1. Insulation:
   a. Armacell LLC Armaflex
   b. K-Flex
   c. Or approved equivalent.
2. Glue:
   a. Armacell LLC Armaflex Low VOC Adhesive
   b. K-Flex
   c. Or approved equivalent.
3. Paint:
   a. Armacell LLC Armaflex
   b. K-Flex
   c. Or approved equivalent.

B. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.

1. Thermal Conductivity Value: As indicated in the insulation tables below.

2. Maximum Service Temperature of 220 degrees F.

3. Maximum Flame Spread: 25.

4. Maximum Smoke Developed: 50 (1-inch thick and below).

5. Vapor Retarder Jacket, for over 1-inch insulation thickness: White Kraft paper reinforced with glass wool and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

6. Connection: Waterproof vapor retarder adhesive as needed.

7. UV Protection: UV outdoor protective coating per manufacturer's requirements.

C. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.

D. Paint (for exterior insulation only): Nonhardening high elasticity type, specifically manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

2.04 ACCESSORIES

A. Acceptable Manufacturers:

1. ITW Insulation Systems

2. Or approved equivalent.

B. Equipment Insulation Jacketing: Presized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.

C. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

D. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water-soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.05 DUCT INSULATION ACCESSORIES

A. Acceptable Manufacturers:

1. Certainteed

2. Johns Manville

3. Owens-Corning

B. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

2.06 DUCT INSULATION COMPOUNDS

A. Acceptable Manufacturers:

1. Certainteed

2. Johns Manville

3. Owens-Corning

B. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated. Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168 in accordance with LLE EQ 4.1

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Verification of Conditions:

1. Do not apply insulation until pressure testing and inspection of ducts and piping has been completed.

2. Examine areas and conditions under which duct and pipe insulation will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

B. Preparation: Clean and dry surfaces to be insulated.

C. Installation:

1. Insulation: Continuous through walls, floors and partitions except where noted otherwise.

2. Piping and Equipment:

a. Install insulation over clean, dry surfaces with adjoining sections firmly butted together and covering surfaces. Fill voids and holes. Seal raw edges. Install insulation in a manner such that insulation may be split, removed, and reinstalled with vapor barrier tape on strainer caps and unions. Do not install insulation until piping has been leak tested and has passed such tests. Do not insulate manholes, equipment manufacturer's nameplates, handholes, and ASME stamps. Provide beveled edge at such insulation interruptions. Repair voids or tears.

b. Cover insulation on pipes above ground, outside of building, with aluminum jacketing. Position seam on bottom of pipe.

D. Cover insulation on exposed refrigerant piping above ground, outside of building with heavy duty multi-layered laminated jacketing tape. Position seams on bottom of pipe. Use Venture Tape VentureClad Plus 1579GCW-E or approved equal.

E. Provide accessories as required. See Part 2 Article "Accessories" above.

F. Protection and Replacement: Installed insulation during construction. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

G. Labeling and Marking: Provide labels, arrows and color on piping and ductwork. Attach labels and flow direction arrows to the jacketing per Section 23 05 53, Identification for HVAC Piping, Ductwork and Equipment.

H. Ductwork:

1. Install insulation in conformance with manufacturer's recommendations to completely cover duct.

2. Butt insulation joints firmly together and install jackets and tapes smoothly and securely.

3. Apply duct insulation continuously through sleeves and prepared openings, except as otherwise specified. Apply vapor barrier materials to form complete unbroken vapor seal over insulation.

4. Coat staples and seals with vapor barrier coating.

5. Cover breaks in jacket materials with patches of same material as vapor barrier. Extend patches not less than 3-inches beyond break or penetration on all directions and secure with adhesive and staples. Seal staples and joints with vapor barrier coating.

6. Fill jacket penetrations. i.e., hangers, thermometers and damper operating rods, and other voids in insulation with vapor barrier coating. Seal penetration with vapor barrier coating. Insulate hangers and supports for cold duct in un-conditioned spaces to extent to prevent condensation on surfaces.

7. Seal and flash insulation terminations and pin punctures with reinforced vapor barrier coating.

8. Continue insulation at fire dampers and fire/smoke dampers up to and including those portions of damper frame visible at outside of the rated fire barrier. Insulating terminations at fire dampers in accordance with this Section.

9. Do not conceal duct access doors with insulation. Install insulation terminations at access door in accordance with this Section.

I. Insulation Shields: Provide hangers and shields (18 gauge minimum) outside of insulation for cold piping (<60 degrees F). Hot water piping hangers may penetrate insulation to contact pipe directly. Provide 18-inch long, noncompressible insulation section at insulation shields for lines 2-inches and larger (hot and cold) piping.

J. Ductwork Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Duct Size	Insulation Thickness
Supply ductwork where duct is not specified to be lined.	A	All	1.5-inch
Return ductwork where duct is not specified to be lined.	--	All	None
Outside Air Ducts	A	All	3-inch
Exhaust ducts within 10-feet of exterior	A	All	3-inch

1. Note: Insulation thickness shown is a minimum. If state codes require additional thickness, then provide insulation thickness per code requirements.

K. Piping Surfaces to be Insulated:

Item to be Insulated	System Insulation Type	Conductivity Range (Btu-inch per hour per SF per degrees F)	Pipe Size (Inches)	Insulation Thickness (Inches)
Refrigerant Suction and Liquid Piping (40F to 60F)	2	0.21-0.27 at a mean rating temperature of 75 degrees F	<1 1 to <1.5 1.5 to <4 4 to <8 >= 8	0.5 0.5 1.0 1.0 1.0

1. Note: Insulation thickness shown is a minimum. If state code requires additional thickness, then provide insulation thickness per code requirements.

3.02 TYPE A, FLEXIBLE GLASS WOOL BLANKET

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Duct Wrap: Cover air ducts per insulation table except ducts internally lined where internal duct lining is adequate to achieve adequate insulating values to meet local Energy Codes (indicate on shop drawings, locations where duct wrap is planned to be omitted and indicate internal duct lining insulating values to confirm they will meet the Energy Code.) Wrap tightly with circumferential joints butted and longitudinal joints overlapped minimum of 2-inches. On ducts over 24-inches wide, additionally secure insulation with suitable mechanical fasteners at 18-inches on center. Circumferential and longitudinal joints stapled with flare staples 6-inches on center and covered with 3-inch wide, foil reinforced tape.

3.03 TYPE B, DUCT LINER

A. Install insulation in conformance with manufacturer's recommendations and requirements.

B. Duct Liners: Mat finish surface on air stream side. Secure insulation to cleaned sheet metal duct with continuous (minimum 90) percent coat of adhesive. Secure liner with mechanical fasteners 15-inches on center or per manufacturer requirements. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation overlap sides. Factory/field coat exposed edges. Metal nosing for exposed leading or transverse edges and when velocity exceeds 3500 FPM or manufacturer rating on exposed edges. Keep duct liner clean and free from dust. At

completion of Project, vacuum duct liner if it is dirty or dusty. Do not use small pieces. If insulation is installed without horizontal, longitudinal, and end joints butted together, installation will be rejected and work removed and replaced with work that conforms to this Specification.

3.04 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

A. Flexible Elastomeric Insulation:

1. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and below grade with two coats of finish as recommended by manufacturer.

B. Flexible Elastomeric Tubing:

1. Flexible Elastomeric Tubing: Slip insulation over piping or, if piping is already installed, slit insulation and snap over piping. Joints and butt ends must be adhered with 520 adhesive.

C. See General Installation Requirements above.

D. Install insulation in conformance with manufacturer's recommendations and requirements.

E. Slip insulation on pipe prior to connection. Butt joints sealed with manufacturer's adhesive. Insulate fitting with miter-cut pieces. Cover insulation exposed to weather and undergrade with two coats of finish as recommended by manufacturer.

F. Install in accordance with manufacturer's instructions for below grade installation.

3.05 ACCESSORIES

A. Install insulation in conformance with manufacturer's instructions, recommendations and requirements.

B. See General Installation Requirements above.

C. Furnish and install accessories for all insulation types listed in this Section.

3.06 DUCT INSULATION ACCESSORIES

A. Install insulation in conformance with manufacturer's recommendations and requirements.

3.07 DUCT INSULATION COMPOUNDS

A. Install insulation in conformance with manufacturer's recommendations and requirements.

END OF SECTION

SECTION 23 09 33

ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Room Thermostats
2. Smoke Detection for Projects with a Building Fire Alarm System
3. Relays and Contactors
4. Transformers
5. Wiring
6. Damper Operators

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:

1. Power wiring per Division 26, Electrical.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Drawings: complete control diagram, including written description of control sequences.
2. Operation and Maintenance Manual: Include record wiring drawings showing installed condition and operating changes made during start-up.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as outlined in Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Within 30 days prior to warranty expiration date, control supplier to visit job site and check calibration, operation, and adjustment of temperature, pressure and humidity sensors, valves, dampers, thermostats and other devices installed by control supplier. Make repair or replacement of defective control equipment as required at no charge to Owner.

2. Submit letter to Architect certifying that this work has been completed.

3. Attach copy of service report signed by Owner's Authorized Representative.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Room Thermostats:

1. Honeywell

2. Siemens

3. Johnson Controls

4. Reliable Controls

5. Alerton

B. Damper Operators:

1. Belimo

2. Honeywell

3. Siemens

4. Or approved equivalent.

2.02 ROOM THERMOSTATS

A. For packaged equipment, including direct expansion split and VRF units, provide thermostats/controllers as manufactured by packaged equipment manufacturer.

B. Electronic Thermostat:

1. Seven day programmable, PI control.

2. Occupied/unoccupied heat and cool setpoints.

3. Automatic heat/cool changeover and fan control.

4. Touch screen display.

5. Cooling Stages: Provide as required to match in air conditioner.

6. Basis of Design: Honeywell RTH 7600D.

C. Line Voltage, Cooling Thermostat: Wall mounted thermostat, non-programmable, dial adjustment between 44 degrees F and 86 degrees F, gold color. Basis of Design: Honeywell T65.

2.03 RELAYS AND CONTACTORS

A. Provide relays and contactors where required or as shown on Drawing to meet operating sequence where not internal to manufacturer's equipment.

B. Furnish relays or contactors with required coil voltage and contact amperage rating for use specified on Drawing and in manufacturer's equipment.

C. Mount relays in single control cabinet with hinge door and latch.

D. Control cabinet contains relays and numbered terminal strips for connection of relays and field wiring. Mount cabinet on painted plywood panel securely attached to wall framing. Mount time clock, transformer and motor contactors (if required) on plywood adjacent to control panel.

2.04 TRANSFORMERS

A. Transformers selected and sized for appropriate VAC capacity and installed and fused according to applicable codes. Provide wiring to nearest suitable power source as required.

2.05 WIRING

A. In accordance with Division 26, Electrical and applicable codes.

B. Provide line and low voltage wiring relating to control system. Includes wiring of contactors, relays, circuits, and incidental power wiring: operation power for time clock, power when run through stat/timeclock/relay, transformers.

2.06 DAMPER OPERATORS

A. Size operators to operate dampers properly against system pressures, pressure differentials and velocities. Damper operators sized for 150 percent of damper forces normally encountered. Spring return closed for outside air applications.

PART 3 - EXECUTION

3.01 SEQUENCE OF OPERATION

A. Split Systems: Room thermostats to modulate economizer cycle, cooling and heating in sequence to maintain setpoints of 75 degrees F in cooling and 70 degrees F in heating. Provide motorized low leakage outside air dampers. Dampers to be closed on fan shutdown. Program thermostats to time schedule coordinated with Owner. See below for fire shut-down.

B. Unit Heaters: Install manufacturer’s furnish thermostat as shown on drawings. Program 55 degrees F heating setpoint. Heater to run off own internal controls.

C. Exhaust Fans:

1. Exhaust Fans (EF-1): Controlled from line voltage cooling thermostat. Open motorized intake and exhaust dampers prior to starting fan.

3.02 SMOKE DETECTION (FOR PROJECTS WITH A FIRE ALARM SYSTEM)

A. Smoke detector furnished and powered/wired. Coordinate with fire alarm equipment supplier. Installation of duct smoke detector housing and sampling tube under Division 23, HVAC.

B. Install smoke detectors in return air systems greater than 2000 CFM.

3.03 INSTALLATION OF AUXILIARY CONTROL DEVICES

A. General:

1. Install sensors and thermostats in accordance with manufacturer's recommendations.

2. Room sensors and thermostats installed at 48-inches AFF to midline of sensor on concealed junction boxes properly supported by wall framing at the locations shown on the Drawings.

B. Actuators:

1. General:

a. Mount and link control damper actuators according to manufacturer's instructions.

b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.

2. Actuator Mounting for Damper arrangements to comply to the following:

a. Damper Actuators: Do not install in the air stream.

b. Use a weather proof enclosure (clear and see through) if actuators are located outside.

c. Damper or valve actuator ambient temperature not-to-exceed 122 degrees F through any combination of medium temperature or surrounding air. Provide appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation as necessary. Mount per manufacturer's recommendations.

d. Actuator cords or conduit to incorporate a drip leg if condensation is possible. Do not allow water to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point to be avoided to prevent water from condensing in conduit and running into actuator.

END OF SECTION

SECTION 23 21 13

HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Equipment Drains and Overflows
2. Unions
3. Refrigerant Piping

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Welding Certificates: Copies of certificates for welding procedures and personnel.
2. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Failed test results and corrective action taken to achieve requirements.
3. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at project site.
4. Grooved couplings, fittings, valves, and specialties: Show grooved joint couplings and fittings on Shop Drawings and product submittals, and specifically identify with the applicable coupling style number.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with documented experience.

2. Welder Qualifications: Certify in accordance with ASME (BPV IX).

3. ASME Compliance: Comply with ASME B31.9 "Building Services Piping" for materials, products, and installation. Provide safety valves and pressure vessels with the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.

4. Grooved couplings, fittings, valves, and specialties: Provide all grooved couplings, fittings, valves, and specialty products from a single manufacturer. Utilize only grooving tools from the same manufacturer as the grooved components. Date-stamp all castings used for couplings housings, fittings, or valve and specialty bodies for quality assurance and traceability.

5. Refrigerant Piping:

   a. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX "Welding and Brazing Qualifications."

   b. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."

   c. ASME Standard: Comply with ASME B31.5, "Refrigeration Piping."

   d. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical" or UL 429 "Electrically Operated Valves."

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.

2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inch or larger or piping routed over food preparation centers, food serving facilities, food storage areas, computer rooms, telecommunications rooms, and electrical rooms.

2.02 UNIONS

A. Unions for Pipe 2-inches and Under:

1. Ferrous Piping: 150 PSIG malleable iron, threaded, ASME B16.39.

2. Copper Pipe: Bronze, soldered joints, ASME B16.22.

B. Dielectric Connections: Provide dielectric waterway or brass nipple fitting with threaded ends. Dielectric unions are not allowed.

2.03 REFRIGERANT PIPING

A. Piping:

1. Copper Tube: ASTM B 280, Type ACR, annealed-temper tube, clean, dry and capped.

a. Fittings: ASME B16.22 wrought copper.

b. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy (15 percent Silver).

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install per manufacturer's written instructions and requirements.

B. Preparation:

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

2. Remove scale and dirt on inside and outside before assembly.

3. Prepare piping connections to equipment with flanges or unions.

4. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

C. Field Quality Control:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush system with clean water. Clean strainers.

4. Isolate equipment from piping. If a valve is used to isolate equipment, provide closure capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

6. Perform the following tests on hydronic piping:

a. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

b. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.

c. Check expansion tanks to determine that they are not air bound and that system is full of water.

d. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure not-to-exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."

e. After hydrostatic test pressure has been applied for at least four hours, examine piping, joints and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

f. Prepare written report of testing.

D. Pipe Painting Requirements:

1. Paint all ferrous metal pipe including flanges. Do not paint flange bolts, washers and nuts. At flexible coupling the only the flanges are to be painted. All rubber portions are to remain unpainted.

2. Paint exterior uninsulated steel piping with exterior latex, semi-gloss (AE), Master Painters Institute MPI 11, suitable for metallic surfaces B, Haze Gray color.

3. Use ready-mixed (including colors) paint. Prime paint with pigment and vehicle, compatible with substrate and finish coats specified. Volatile Organic Compounds (VOC) content of paint materials shall not exceed 50g/l for exterior latex paints and primers. Lead-based paint is not permitted.

4. Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point.

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the product manufacturer.

5. Do no exterior painting when it is windy and dusty. Do not paint in direct sunlight or on surfaces that the sun will soon warm.

6. Apply only on clean, dry and frost-free surface. Remove all materials the will affect the ability of the paint to adhere to the pipe including painted pipe identification labels.

7. Remove oil, grease, soil, drawing and cutting compounds, flux and other detrimental foreign. Remove loose mill scale, rust, and paint, by hand or power tool cleaning. All surfaces are to be dry at the time paint is applied.

8. Apply paint in two coats; prime, and finish. Apply each coat evenly and cover substrate completely. Allow not less than 48 hours between application of succeeding coats, except as allowed by manufacturer's printed instructions.

9. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects. Apply by brush, roller or spray.

3.02 REFRIGERANT PIPING INSTALLATION

A. Install systems in accordance with ASHRAE Standard 15.

B. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

C. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

D. Flood piping system with nitrogen when brazing.

E. Follow ASHRAE Standard 15 procedures for charging and purging of systems and for disposal of refrigerant.

F. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

G. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

H. Fully charge completed system with refrigerant after testing.

I. Field Quality Control:

1. Test refrigeration system in accordance with ASME B31.5.

2. Pressure test system with dry nitrogen to 200 PSI. Perform final tests at 27-inches vacuum and 200 PSI using electronic leak detector. Test to no leakage.

END OF SECTION

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SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Ductwork, Joints and Fittings
2. Drain Pans
3. Ductwork Joint Sealers and Sealants

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:

1. Section 23 05 29, Hangers and Supports for HVAC Piping, Ductwork and Equipment.
2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Welding Certificates
2. Field Quality Control Reports

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. NFPA Compliance:
   a. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
   b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
2. Comply with NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations, Ch. 3, Duct System for range hood ducts, unless otherwise indicated.

3. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Provide sheet metal materials free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Duct design is generally diagrammatic and is not meant to be scaled. Major changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

PART 2 - PRODUCTS

2.01 DUCTWORK, JOINTS AND FITTINGS

A. Manufacturers:

1. Ductmate
2. Lindab Inc.
3. Nexus Inc.
4. SEMCO
5. United McGill Corporation
6. Ward Industries

B. Materials:

1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, lock-forming quality, ASTM A 653/A 653M FS Type B, with G90/Z275 coating, minimum 26 gauge except where heavier material is specifed. Ducts to have mill phosphatized finish for surfaces exposed to view.

C. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems not-to-exceed deflection limits according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
3. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

D. Formed-On Flanges: construct according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Duct Size: Maximum 30-inches wide and up to 2-inch wg pressure class.

2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

3. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19-inches and larger and 0.0359-inch thick or less, with more than 10 SF of nonbraced panel area unless ducts are lined.

E. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of material specified in this Section according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

1. Ducts up to 20-inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

2. Ducts 21- to 72-inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.

3. Ducts Larger than 72-inches in Diameter: Companion angle flanged joints per SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2.

4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

F. 90-Degree Tees and laterals and Conical Tees: Fabricate to comply with SMACNA's HVAC Duct Construction Standards-Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.

G. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

H. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows to be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's HVAC Duct Construction Standards-Metal and flexible, unless otherwise indicated.

2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):

   a. Ducts 3- to 36-inches in Diameter: 0.034-inch .

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:

   a. Ducts 3- to 26-inches in Diameter: 0.034-inch.

   b. Ducts 27- to 50-inches in Diameter: 0.040-inch.

4. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

5. Round Elbows:

   a. 8-inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend-angle configurations or non-standard diameter elbows with gored construction.

   b. 9 through 14-inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60 and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

   c. Larger than 14-inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

6. Die-Formed Elbows for Sizes through 8-inches in Diameter and Pressures 0.040-inch thick with two-piece welded construction.

7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

8. Pleated Elbows for Sizes through 14-inches in Diameter and Pressures through 10-inch wg (2500 Pa): 0.022-inch.

9. Not acceptable:

   a. Corrugated or flexible metal duct.

   b. Adjustable elbows.

2.02 DRAIN PANS

A. Primary Drain Pans: Stainless Steel, Fabricated in accordance with ASTM A167 and A480.

B. Secondary Drain Pans: Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating.

2.03 DUCTWORK JOINT SEALERS AND SEALANTS

A. Manufacturers:

1. Ductmate
2. Duro Dyne
3. Hardcast
4. United McGill Corporation
5. Vulkem
6. Foster
7. Childer

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

C. Low Emitting Materials Requirement: Adhesives, sealants and sealant primers must comply with: South Coast Air Quality Management District (SCAQMD) Rule #1168.

D. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure and leakage class of ducts.

E. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.

F. Water Based Sealant for Brush-On Application: Flexible, adhesive sealant, resistant to UV light, UL-181A, and UL-181-B listed, complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Hardcast Versa-Grip 181; Childers CP-146; Foster 32-19 for SMACNA 1/2, 1, 2, 3, 4, 6, and 10-inch WG duct classes, and SMACNA Seal Class A, B, or C.

G. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.

H. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

I. Polyurethane Sealant: General-purpose, exterior use, non-brittle sealant for gunned application. Vulkem 616 or equal.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. General: Use the following pressure seal, and leakage class(es) in design of ductwork specified in this section unless otherwise noted on Drawings.

System	Pressure Class (Inches of Water)	Seal Class	Leakage Class Round Ducts	Leakage Class Rectangular Ducts
Low pressure	+ 1-inch	A	3	6
Return and exhaust	0.5-inch more negative than return/exhaust fan pressure or -2-inch pressure class, whichever is more negative.	A	3	6

B. Ductwork Installation:

1. General: Install entire duct system in accordance with drawings, Specifications, and latest issues of local Mechanical Code, NFPA 90A, and SMACNA Duct Construction Manual. At Contractor's option, rectangular ductwork may be resized to maintain an equivalent air velocity and friction rate, while maintaining a maximum aspect ratio of 3. Remove markings and tagging from ductwork exterior surface in mechanical rooms and other locations where ductwork is exposed.

2. The duct layout shown on the Contract Drawings is diagrammatic in nature. Coordinate the ductwork routing and layout, and make alterations to the ductwork routing and layout to eliminate physical interferences. Where deviations in the ductwork routing as shown in the Contract Drawings are required, alterations may be made so as not to compromise the air flow, pressure drop, and sound characteristics of the duct fitting or duct run as shown on the Contract Drawings. In the event Architect determines that the installed ductwork is inconsistent with the above mentioned criteria, remove and replace at no additional cost to the Owner.

3. Install ducts with fewest possible joints.

4. Install fabricated fittings for changes in directions, size, shape, and for connections.

5. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12-inches, with a minimum of 3 screws in each coupling.

6. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

7. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

8. Install ducts with a clearance of 1-inch, plus allowance for insulation thickness. Allow for easy removal of ceiling tile.

9. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

10. Coordinate layout with suspended ceiling, air duct accessories, lighting layouts, and similar finish work.

11. Electrical and IT Equipment Spaces: route ducts to avoid passing through transformer vaults, electrical equipment spaces, IDF/MPOE rooms, and enclosures.

12. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2-inches.

13. Fire- and Smoke-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire, smoke or combination fire and smoke dampers as governed by Building Code and AHJ, including sleeves, and firestopping sealant.

14. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by applicable building codes. Reference SMACNA's Seismic Restraint Manual: Guidelines for Mechanical Systems, Mason Seismic Restraint and Support Systems.

15. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's Duct Cleanliness for New Construction Advanced Level.

16. Paint interiors of metal ducts, that do not have duct liner, for 24-inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible duct material.

17. Install ductwork in the location and manner shown and detailed. Review deviations required by job conditions with Architect prior to any fabrication. Provide fittings for construction per SMACNA.

18. Install flexible ductwork to limit sag between support hangers to 1/2-inch per foot of spacing support.

C. Flanged Take-Offs:

1. Install at branch takeoffs to outlets using round or flex duct.

2. Flanged take-offs secured with minimum 8-inch screw spacing (three screws minimum).

3. Provide ductwork taps and branches off of main ducts at 45 degrees whether shown on Drawings or not (drawings are diagrammatic).

D. Cleaning:

1. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

2. Grille and Exposed Duct Cleaning:

a. After completion of ductwork installation, operate each fan system (excluding exhaust fans) for a minimum of 30 minutes prior to installation of ceiling grilles and diffusers. After grilles and diffusers are installed, clean out accumulation of particles from grilles and diffusers prior to acceptance.

b. Clean exterior surface of ducts exposed to public view of chalk, pencil and pen marks, labels, sizing tags, dirt, dust, etc., so that upon completion of installation, ducts are left in clean and unblemished manufactured conditions.

c. Exposed duct and grilles to remain free of dust entrained streaks due to leakage at joints and grille connections during warranty period. Clean leaks, seal and refinish to match existing if visible streaks develop.

3.02 DUCTWORK, JOINTS AND FITTINGS INSTALLATION

A. Duct Materials - Applied Locations:

1. General: Use the following materials in design of ductwork specified in this Section unless otherwise noted on the Drawings.

Location or Application	Material
Supply, Return, Transfer, and Exhaust - Low Pressure	Single Wall, Galvanized Steel

B. Ductwork Installation:

1. Fabricate radius elbows with centerline radius not less than 1-1/2 duct diameters.

2. Do not install duct size transition pitch angles which exceed 30 degrees for reductions in duct size in the direction of airflow, and 15 degrees for expansions in duct size in the direction of airflow.

3. Install fixed turning vanes in square throat rectangular elbows and in tees.

4. Fabricate duct turns with the inside (smallest) radius at least equal to the duct width (supply ducts) and 1.5 times radius (return and exhaust ducts). Where necessary, square elbows may be used, with maximum available inside radius and with fixed turning vanes. In healthcare settings such as hospitals and medical office buildings, square elbows and turning vanes allowed on supply ductwork only.

3.03 DRAIN PANS INSTALLATION

A. Install where shown on Drawings. Drain provided by Division 22, Plumbing. Provide drain (sized per code) connection from each drain pan and pipe to nearest floor drain through trap and 10-inch air gap. Drain pans over 6-feet in length require drain connections from both ends. Pitch drain pans in direction of air flow and to drain. Support secondary drain pan independently from equipment.

3.04 DUCTWORK JOINT SEALERS AND SEALANTS INSTALLATION

A. Joints and Seam Joint Sealing:

1. Seal duct seams and joints according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, for duct pressure class indicated.

2. Seal transverse joints, longitudinal seams and duct wall penetrations including screw, fastener, pipe, rod, and wire.

3. Seal ducts before external insulation is applied.

4. Tape joints of PVC coated metal ductwork with PVC tape.

5. Fasteners such as sheet-metal screws, machine screws or rivets to be cadmium plated.

6. Rectangular Ductwork: Where intermediate joint reinforcement is required for duct of negative pressure class, pre-drill stiffening flange and provide fastener maximum 8-inches on center. Where retaining flanges are welded to duct wall, paint welds with zinc coating.

7. Single Wall Round Ductwork: Joint to incorporate beaded slip collar with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.

8. Seal joints and seams. Apply sealant to make end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

9. Double Wall Round Ductwork: Joint to incorporate beaded slip collar or flanged connection, with minimum #8 sheet metal screws 8-inches on center. Seal ductwork as specified in this Section.

10. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

11. Provide openings in ductwork where required to accommodate thermometers and control devices. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

12. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities as well as Code required clearances.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Sheet Metal Materials
2. Backdraft Dampers
3. Dampers
4. Concealed Damper Hardware
5. Access Doors
6. Duct Test Holes
7. Turning Vanes
8. Flexible Connectors

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Manufacturer's catalog data and fabrication/installation drawings for each factory fabricated duct accessory. Include leakage, pressure drop and maximum back pressure data.
2. Shop Drawings: Indicate air duct accessories.
3. Manufacturer's installation instructions: Provide instructions for each factory fabricated duct accessory.
4. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    a. See Division 01, General Requirements, Product Requirements for additional provisions.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.

2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

3. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.

4. AMCA 511 - Certified Ratings Program for Air Control Devices.

5. AMCA 611, latest edition - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations.

6. AMCA 610, latest edition - Laboratory Methods of Testing Airflow Measurement Stations for Performance Rating.

7. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M. Galvanizing: 1-1/4 ounces per square foot total both sides; ducts to have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

2.02 BACKDRAFT DAMPERS

A. Manufacturers:

1. Air Balance

2. Cesco

3. Greenheck

4. Nailor

5. Ruskin

B. Basis-of-Design: Ruskin CB D6.

C. Description: Multiple-blade gravity balanced with center pivoted blades with sealed edges, assembled in rattle free manner with 90-degree stop, adjustment device to permit setting for varying differential static pressure.

D. Frame: 0.125-inch thick 6063-T5 extruded aluminum channel with galvanized steel braces at mitered corners. Provide mounting flange.

E. Blades: Single piece, overlap frame, parallel action, horizontal orientation, minimum 0.07-inch 6063-T5 extruded aluminum material, maximum 6-inch width.

F. Bearings: Corrosion-resistant synthetic, formed as single piece with axles.

G. Blade Seals: Extruded vinyl, mechanically attached to blade edge.

H. Blade Axles: Corrosion-resistant, synthetic formed as single piece with bearings, locked to blade.

I. Tie Bars and Brackets: Galvanized steel.

J. Return Spring: Adjustable tension.

K. Damper Capacity:

1. Closed Position: Maximum back pressure of 16-inches water gauge.

2. Open Position: Maximum air velocity of 2,500-feet per minute.

L. Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade. Must be capable of operating over wide range of pressures.

M. Finish: Mill aluminum.

N. Temperature Rating: -40 degrees F to 200 degrees F.

O. Operation of Blade:

1. Start to Open: 0.01-inch wg

2. Fully Open: 0.05-inch.

P. Pressure Drop: Maximum 0.15-inch wg at 1,500-feet per minute through 24-inch by 24-inch damper.

Q. Factory Sleeve: Minimum 20 gauge thickness, 12-inches in length.

R. Screen: At outdoor intake or discharge. 1/4-inch aluminum.

2.03 DAMPERS

A. Manufacturers:

1. Air Balance

2. Cesco

3. Greenheck

4. Nailor

5. Ruskin

B. Basis-of-Design:

1. Rectangular ductwork for velocities and pressures up to 1,500 fpm and 2.5-inch wg, respectively: Ruskin MD-35.

2. Rectangular ductwork for velocities and pressures up to 3,000 fpm and 4-inch wg, respectively: Ruskin CD-60.

3. Round ductwork for velocities and pressures up to 3,000 fpm and 4-inch wg, respectively: Ruskin CDSR-15.

C. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

D. Rectangular Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design with linkage concealed in frame and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.

a. Roll-Formed Steel Blades: Galvanized sheet steel, 16 gauge thick for velocities up to 1,500 fpm, and 14 gauge thick for velocities up to 3,000 fpm.

b. Blade Axles: Minimum 1/2-inch diameter, plated steel, hex shaped, mechanically attached to blade.

c. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.

d. Tie Bars and Brackets: Galvanized steel.

e. Mill galvanized.

E. Round Volume Dampers: Single-blade suitable for horizontal or vertical applications.

1. Steel Frames: Galvanized, roll formed, minimum of 20 gauge thick with beads at each end.

2. Blades: Minimum 14 gauge thick, galvanized sheet steel, round, single-piece.

3. Blade Axles: Minimum 1/2-inch square, plated steel, mechanically attached to blade.

4. Bearings: Molded synthetic sleeve, turning in hole in frame.

5. Finish: Mill galvanized.

6. Capacity:

a. Closed Position: Maximum pressure of 4-inches wg.

b. Open Position: Maximum air velocity of 3,000-feet per minute.

7. Leakage: Maximum 20 cfm at 4-inches wg.

8. Pressure Drop: Maximum 0.02-inch wg at 1,500-feet per minute through 20-inch diameter dampers.

F. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

2. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include 2-inch elevated platform for insulated duct mounting.

2.04 CONCEALED DAMPER HARDWARE

A. Manufacturers:

1. Young Regulator Company

B. Concealed Damper Hardware: For dampers above non-removable ceilings (gyp, plaster, decorative, etc.) where access panels have not been shown on Architectural drawings or in locations where dampers are more than 2-feet above the ceiling, provide:

1. Concealed Damper Regulator: Young Regulator Company Model 315 or approved equivalent.

2. Cable System: Young Regulator Company or approved equivalent.

3. Controller: Young Regulator Company 270-275 or approved equivalent.

4. Control wrenches, wire stops, casing nuts, and stainless steel wire.

5. Paint cover plate to match ceiling color or as directed by Architect.

2.05 ACCESS DOORS

A. Manufacturers:

1. Ductmate

2. Cesco

3. Ruskin

4. Nailor

5. Outdoor Installation: Karp MX insulated exterior access door.

B. Duct Pressure Class 2-inch WC and Greater: Sandwich-type design with threaded locking bolt assembly. Closed cell neoprene gasket permanently bonded to inside panel. Zinc-coated steel wing nuts or polypropylene molded knobs with threaded metal inserts - zinc coated bolts sealed to inner panel.

C. Duct Pressure Class 1-1/2-inch WC and Less: Galvanized steel assembly incorporating frame, door, hinges, and latch(es). Frame tabbed for attachment to duct panel. Double wall door panel with 1-inch insulation. Open cell neoprene gasket attached to frame. Cam latches for tight closure.

D. Plenum Doors: Extruded aluminum frames with extruded santoprene seals. Double-wall 20 gauge galvanized steel door panel with fiberglass insulation.

E. Size: Maximum size available to fit rectangular duct panel dimension or round duct diameter. Plenum doors minimum 2-feet wide by 4-feet high.

F. For outdoor installation, only provide waterproof access doors installed vertically.

2.06 DUCT TEST HOLES

A. Manufacturers:

1. Ventlok

B. Temporary Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

C. Permanent Test Holes (where shown on Drawings): Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.07 TURNING VANES

A. Manufacturers:

1. Aerodyne
2. Ductmate Industries
3. Duro Dyno Corp.
4. Metalaire Inc.

B. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners to automatically align vanes.

C. Manufactured Turning Vanes: For medium pressure ductwork, ductwork upstream of terminal units, and in ductwork with equal inlet width and height dimensions and outlet width and height dimension, provide double thickness airfoil turning vanes. Low pressure ductwork and ductwork downstream of terminal units use either single thickness or double thickness turning vanes. For mitered rectangular elbows with changes in size from inlet to outlet, only use single thickness turning vanes. Use 2-inch radius vanes spaced on centers of 1.5-inches for single thickness. Use 2-inch radius vanes spaced on centers of 2.125-inches for double thickness.

D. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.08 FLEXIBLE CONNECTORS

A. Manufacturers:

1. Duro Dyne Corp.
2. Ventfabrics Inc.
3. Ductmate Industries
4. Hardcast

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 4-inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.

D. Provide a spring and bracket assembly to reinforce the fabric with sufficient tension to prevent connector collapse under negative or positive pressure. Number and positioning of spring-link fixture to be determined by the manufacturer to maintain straight axis and without kinks between two sections of duct, or between duct and the moving element. Hardcast Spring-Link SL-200, or equal.

E. Indoor System, Flexible Connector Fabric (FC-I): Glass fabric double coated with neoprene.

1. Minimum Weight: 30 ounces per square yard.

2. Tensile Strength: 395 pounds of force per inch in the warp and 255 pounds of force per inch in the filling.

3. Service Temperature: -40 degrees F to 200 degrees F.

PART 3 - EXECUTION

3.01 DUCT ACCESSORIES GENERAL INSTALLATION

A. Inspect areas to receive air duct accessories. Notify Engineer of conditions that would adversely affect the installation of the dampers. Do not proceed until conditions are corrected.

B. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

C. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

D. Do not compress or stretch damper frames into duct or opening.

E. Handle dampers using sleeve or frame. Do not lift dampers using blades, actuators, or jack shafts.

F. Adjust duct accessories for proper settings.

3.02 SHEET METAL MATERIALS INSTALLATION

A. Install bracing for multiple sections to support assembly weights and hold against system pressure. Install bracing as needed.

3.03 BACKDRAFT DAMPERS INSTALLATION

A. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated. Provide at outside air intakes where motorized dampers are not shown on drawings.

3.04 DAMPERS INSTALLATION

A. Where installing volume dampers in ducts with liner, avoid damage to and erosion of duct liner.

B. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts for air balancing. Install at a minimum of two duct widths from each branch takeoff. Provide balancing dampers for all air inlets and outlets.

C. Install dampers square and free from racking with blade running horizontally.

3.05 CONCEALED DAMPER HARDWARE INSTALLATION

A. Coordinate location in Reflected Ceiling Plan and color of concealed damper hardware with Architect prior to installation.

3.06 ACCESS DOORS INSTALLATION

A. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. On both sides of duct coils.
2. Downstream from volume dampers, turning vanes and equipment.
3. Adjacent to fire or smoke dampers, providing access to reset or reinstall fusible links.
4. To interior of ducts for cleaning; before and after each change in direction, at maximum 50-foot (15-m) spacing.
5. Install the following sizes for duct-mounting, rectangular access doors:
    a. One-Hand or Inspection Access: 8-inches by 5-inches.
    b. Two-Hand Access: 12-inches by 6-inches.
    c. Head and Hand Access: 18-inches by 10-inches.
    d. Head and Shoulders Access: 21-inches by 14-inches.
    e. Body Access: 25-inches by 14-inches.
    f. Body Plus Ladder Access: 25-inches by 17-inches.
6. Install the following sizes for duct-mounting, round access doors:
    a. One-Hand or Inspection Access: 8-inches in diameter.
    b. Two-Hand Access: 10-inches in diameter.
    c. Head and Hand Access: 12-inches in diameter.
    d. Head and Shoulders Access: 18-inches in diameter.
    e. Body Access: 24-inches in diameter.
7. Label access doors.

3.07 DUCT TEST HOLES INSTALLATION

A. Provide test holes at fan inlets and outlets where indicated and where required for air testing and balancing.

3.08 TURNING VANES INSTALLATION

A. Vanes must be installed, eliminating every other vane is not allowed.

B. Single thickness vanes cannot be over 36-inches long without intermediate vane runner.

C. Install per SMACNA and fasten/support to prevent vibration, noise, and to maintain proper alignment at design velocity.

3.09 FLEXIBLE CONNECTORS INSTALLATION

A. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators. Provide sheet metal weather cover over flexible connections located outdoors. Attach sheet metal to either equipment side or ductwork side, but not both.

B. Per NFPA, do not use flexible connectors on grease exhaust fans.

C. Securely attach spring-lock brackets to the metal strips of the connector collar using No. 8 sheet metal screws.

D. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

E. Adjust the following types in the following locations:

1. FC-I: Indoors.

END OF SECTION

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SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. In-Line Centrifugal Fans

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Certified fan performance curves with system operating conditions indicated.

2. Certified fan sound-power ratings.

3. Motor ratings and electrical characteristics, plus motor and electrical accessories.

4. Material gauges and finishes, including color charts.

5. Dampers, including housings, linkages, and operators.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Motors: Premium efficiency per Section 23 05 13, Common Motor Requirements for HVAC Equipment. Electrically Commutated Motors (ECM) where scheduled on Drawings.

2. Sound power levels as scheduled on Drawings. If not scheduled, within 5 percent of Basis of Design at design flow.

3. Project Altitude: Base air ratings on sea-level conditions for project sites below 2,000 feet in elevation. Base air ratings on actual site elevations for project sites above 2,000 feet in elevation.

4. Operating Limits: Classify according to AMCA 99.

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

6. AMCA Compliance: Products are to comply with performance requirements and are to be licensed to use the AMCA-Certified Ratings Seal.

7. NEMA Compliance: Motors and electrical accessories are to comply with NEMA standards.

8. UL Standard: HVAC Fans are to comply with UL 705. Fans used in grease exhaust applications are to be UL 762 listed for grease exhaust.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.08 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.01 IN-LINE CENTRIFUGAL FANS

A. Manufacturers:

1. Greenheck

2. Cook

3. Twin City

B. Description: In-line centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Wheel: Cast aluminum backward inclined with inlet cone statically and dynamically balanced within its own bearings.

D. Housing:

1. Heavy gauge steel or aluminum housing, suitable for Fan Class, factory standard finish.

2. Removable panels for access to all interior components.

3. Horizontal or vertical configuration, as indicated.

4. Inlet and discharge duct collars.

5. 1-inch thick, 1.5 pounds per cubic foot density fiberglass liner.

6. Aluminum straightening vanes.

7. Support bracket adaptable to floor, sidewall, or ceiling mounting.

E. Bearings and Drives:

1. Bearings: Heavy duty pillow block type, self greasing ball bearings with ABMA 9 life at 50,000 hours.

2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil.

3. Drive: Direct drive matched to fan loads with speed controller. Motor encased in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.

a. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.

F. Accessories:

1. Variable-Speed Controller: Provide solid-state control to reduce speed from 100 percent to less than 50 percent for motors 1/2 HP or smaller.

G. Vibration isolation as scheduled and specified. Reference Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.

1. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install in accordance with manufacturer's instructions.

B. Install power ventilators level and plumb.

C. Install floor-mounting units on concrete bases.

D. Units using vibration isolation devices are scheduled on Drawings.

E. Support suspended units from structure threaded steel rods and vibration isolation device scheduled on Drawings.

F. In seismic zones, restrain support units.

G. Install units with clearances for service and maintenance.

H. Provide fixed sheaves required for final air balance.

I. Provide safety screen where inlet or outlet is exposed.

J. Pipe scroll drains to nearest floor drain.

K. Provide backdraft dampers on discharge of exhaust fans and as indicated on Drawings.

L. Duct installation and connection requirements are specified in other Division 23, HVAC Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors per Section 23 33 00, Air Duct Accessories.

M. Install ducts adjacent to power ventilators to allow service and maintenance.

N. Ground equipment.

O. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

P. Equipment Startup Checks:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Verify lubrication from bearings and other moving parts.

6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

7. Disable automatic temperature-control operators.

Q. Starting Procedures:

1. Energize motor and adjust fan to indicated rpm.

2. Measure and record voltage and amperage.

R. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

S. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

T. Shut unit down and reconnect automatic temperature-control operators.

U. Replace fan and motor pulleys as required to achieve design airflow.

V. Provide totally enclosed fan cooled motors when motor is located outdoors, whether under a cover or not, or exposed to moisture. Provide protective covering for electronically commutated motors located in outdoor or wet/wash-down locations.

W. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

X. Adjust damper linkages for proper damper operation.

Y. Adjust belt tension.

Z. Lubricate bearings.

AA. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

BB. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

CC. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC fans. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

END OF SECTION

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SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Grilles, Registers, Diffusers
2. Louvers

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size and accessories furnished.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Air Distribution Diffuser, Register, and Grille Schedule lists Basis of Design, with any specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design:
   a. Construction materials and appearance.
   b. Frame/installation method.
   c. Isothermal throw plus or minus 5 percent at design flows shown on drawings.
   d. Noise Criteria: NC value plus or minus 1 at design flows shown on drawings.

e. Accessories: Equal to Basis of Design.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23, HVAC sections, where more than a single type is specified for the application, provide single selection for each product category.

B. Grilles, Registers, Diffusers:

1. Carnes
2. Environmental Air Products
3. Krueger
4. Metalaire
5. Nailor
6. Price Co.
7. Titus
8. Or approved equivalent.

C. Louvers:

1. Ruskin Manufacturing
2. Pottorff
3. Carnes
4. Cesco
5. Greenheck
6. Or approved equivalent.

2.02 GRILLES, REGISTERS, DIFFUSERS

A. Diffuser, Register and Grille Schedule lists Basis of Design, with specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design, including accessories and finish:

1. Matching construction materials and appearance. Equal installation method/frame.
2. Pressure drop equal to or less than Basis of Design at CFM on Drawings.
3. Throw: Isothermal jet throw plus or minus 5 percent of Basis of Design at CFM listed on Drawings.

4. Noise Criteria: Plus or minus 1 NC of Basis of Design at CFM listed on Drawings. If Basis of Design NC is below registered level, submitted must match. NC rating with 10 dB room factor or less.

B. Provide 1-, 2-, 3-, or 4-way deflection as indicated on Drawings.

C. Provide pattern controllers for linear supply air diffusers.

D. Register Dampers: Dampers utilized with grilles. Opposed blade dampers utilizing a side operated worm drive which provides external duct operation. Slot the end of the shaft to receive a screwdriver. Factory assembled side operator. Construct of the same material as the grille. Manufacturer same as grilles/diffuser.

E. Coordinate mounting frames with ceiling construction type. Verify per reflected ceiling plans.

2.03 LOUVERS

A. General: Frame and sill styles compatible with adjacent substrate, specifically manufactured to fit into construction openings with accurate fit and adequate support for weatherproof installation. Reference Drawings and Specifications for types of substrate which will contain each type of louver. Construct of aluminum extrusions, ASTM B221, Alloy 6063-T5. Weld units or use stainless steel fasteners. On inside face of exterior louvers, provide anodized aluminum wire bird screen mounted in removable extruded aluminum frames. AMCA licensed performance ratings.

B. Blades set 3 to 5-inches on center, 37.5 degree angle with rain hook on blade, minimum blade thickness 0.080-inch, drainable blade style. Minimum 57 percent free area for 48-by 48-inch unit. Maximum water penetration 0.01 ounce water psf free area at 1000 FPM. Maximum intake pressure drop of 0.10-inch wg at 750 FPM free velocity. Provide downspouts in jambs, designed to drain water from louver for minimum water cascade from blade to blade. Provide drain gutter in head frame and each blade.

C. Reference Drawings for free area required.

D. Provide access door in duct to clean birdscreen.

E. Finish: Factory Kynar 500 fluoropolymer spray finish; color to be selected by Architect. Conform to AAMA 605.2. Apply coating following cleaning, and pretreatment. Dry louvers before final finish application. 1.2 mils total dry film thickness when baked at 450 degrees F for ten minutes.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Install in accordance with manufacturer's instructions. Provide seismic supports, clips, and bracing per local code. Coordinate installation of framing. Provide complete coverage of rough openings by integral device flanges or auxiliary frames. Where above ceiling location is unconditioned space, caulk rough openings; repair and re-paint locations where dust entrainment streaks develop due to unsealed openings.

B. Damp locations, such as lockers, restrooms, showers, natatoriums, whirlpool/spas, to have aluminum construction even if scheduled otherwise; mounting hardware to be stainless steel.

C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

D. Unless otherwise shown on drawings, for ceiling mounted air outlets with adjustable airflow pattern controllers mounted at a height of 12 feet or less, adjust the air outlets for horizontal air distribution, and adjust to vertical air distribution for ceiling height above 12 feet.

E. Exterior color of grilles per Architect. White finish if not otherwise scheduled or noted by Architect. Paint ductwork visible behind air outlets and inlets matte black.

F. Ceiling Membrane: Protect ceiling membrane per code. Fire caulk around openings. Provide listed radiation damper in rated roof/ceiling or floor/ceiling assemblies as required per code.

G. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

3.02 GRILLES, REGISTERS AND DIFFUSERS INSTALLATION

A. Coordinate with Architectural Reflected Ceiling Plan(s). Reflected ceiling plans determine final locations.

B. Install diffusers to ductwork with air tight connection. 18-inch straight duct section or acoustic plenum at connection. Provide square to round adapters where required for connection to round ducts.

C. Provide integral balancing dampers for diffusers, and grilles and registers where duct manual balancing dampers are not shown or specified.

END OF SECTION

SECTION 23 40 00

HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Disposable Panel Filters

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

B. In addition, reference the following:

1. Division 01, General Requirements, Temporary Facilities and Controls: Filters for temporary heating and ventilating.

2. Division 26, Electrical, Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. ANSI/AHRI 850 I-P - Performance Rating of Commercial and Industrial Air Filter Equipment.

2. ASHRAE Std 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

3. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

4. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods; Military Specifications and Standards.

5. UL 586 - High Efficiency, Particulate, Air Filter Units; Underwriters Laboratories Inc.

6. UL 867 - Electrostatic Air Cleaners; Underwriters Laboratories Inc.

7. UL 900 - Standard for Air Filter Units; Underwriters Laboratories Inc.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, provide:

1. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

2. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.

3. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.

4. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

5. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

a. See Division 01, General Requirements for additional provisions.

b. Extra Filters: One set of each type and size.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

B. In addition, meet the following:

1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 PERFORMANCE REQUIREMENTS

A. Conform to ANSI/AHRI 850 I-P - Performance Rating of Commercial and Industrial Air Filter Equipment, Section 7.4.

1. Dust Spot Efficiency: Plus or minus 5 percent.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Filters:

1. American Filtration Inc.

2. AAF International/American Air Filter

3. Camfil Farr Company

4. Eco-Air Products

5. Filtration Group

6. Flanders Corporation

2.02 DISPOSABLE PANEL FILTERS

A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.

1. Nominal Size: 12 x 24-inches.

2. Thickness: 2-inch.

B. Performance Rating:

1. Face Velocity: 500 FPM.

2. Face Velocity: 350 FPM (2.54 m/sec).

3. Initial Resistance: 0.15-inch WG.

4. Initial Resistance: 0.23-inch WG (37 Pa).

5. Recommended Final Resistance: 0.50-inches WG.

6. MERV Rating: 8.

C. Holding Frames: 20 gauge minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Furnish and install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position/location. Adjust and level.

D. Operation During Construction: If air handlers are operated during construction, provide treated 2-inch media construction filter in front of prefilters and replace periodically to prevent dirt carryover. Install clean prefilters prior to air balancing.

E. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

F. Provide filter gauges on filter banks, installed with separate static pressure tips upstream and downstream of filters.

END OF SECTION

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SECTION 23 81 26

SMALL SPLIT SYSTEM AND UNITARY HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included: Materials, installation and testing of:

1. Split System Condensing Unit
2. Split System Indoor Fan Coil Unit

1.02 RELATED SECTIONS

A. Contents of Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.

B. In addition, meet the following:

1. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.

B. In addition, meet the following:

1. Efficiency ratings, cooling/heating performance, fan performance, sound performance to meet or exceed Basis of Design as scheduled on Drawings.

1.06 WARRANTY

A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 1, General Requirements.

B. In addition, provide:

1. Refrigeration compressor(s): 5-year warranty.

PART 2 - PRODUCTS

2.01 SPLIT SYSTEM CONDENSING UNIT

A. Manufacturers:

1. Trane

2. York

3. Carrier

4. Daikin

5. Or approved equivalent.

B. Description: Cooling operation, Energy Star labeled. Unit matched to indoor evaporator fan unit, vibration isolators, and low ambient operation to 40 degrees F.

C. Cabinet: Fabricated of galvanized steel and finished with powder coated baked enamel with Hail Guard.

D. Refrigeration System:

1. HFC Refrigerant or other refrigerant with zero ozone depletion potential (ODP).

2. Hermetically sealed compressor, high efficiency, 2-stage operation (if equipped), variable speed compressor, integral high/low pressure and temperature protection, liquid line filter dryer.

3. Options:

a. Long line accessory kit.

b. Solenoid valve.

c. Crankcase heater.

E. Condenser Air System:

1. Condenser Fan: Propeller type with direct drive motor, low sound generator, variable speed condenser fan.

2. Condenser Fan Motor: Premium efficiency, permanently lubricated, totally enclosed with built-in current and thermal overload protection.

3. Condenser Coil: Copper tubes mechanically bonded into aluminum fins.

a. Provide corrosion protection coating.

b. Provide Hail Guard.

F. Condensate: Collection in galvanized steel drain pan sloped to drain away from the unit.

G. Controls: Completely internally wired, microprocessor, high and low pressure cutouts, contractors and internal overload protection on all motors. Provide low ambient operation to 40 degrees F outside to maintain condensing temperature on part load operation. Provide anti-short cycle timer and time delay between compressor operation.

2.02 SPLIT SYSTEM INDOOR FAN COIL UNIT

A. Manufacturers:

1. Trane

2. York

3. Carrier

4. Daikin

5. Or approved equivalent.

B. Indoor fan unit matched to outdoor condensing unit. Self-contained, packaged, factory-assembled, pre-wired unit with direct expansion evaporator coil, cabinet supply fan, filter housing and controls. Accessories, economizer assembly, etc. as scheduled and shown on Drawings.

C. Components:

1. Steel cabinet with baked enamel finish or galvanized steel; minimum 1/2-inch thick, 1-1/2# liner with cleanable facing or solid interior metal panel, filter housing suitable for 2-inch thick filter. Easily removed access panels.

2. Economizer/Mixing Box with damper actuator.

D. Refrigeration System: HFC Refrigerant or other refrigerant with zero ozone depletion potential (ODP).

E. Air System:

1. Supply Fan (Evaporator Fan): centrifugal ECM motor drive with internal vibration isolation.

2. Evaporator Motor: Premium efficiency with permanently lubricated bearings thermal overload protection. Provide optional high static motor.

3. Evaporator Coil: Seamless copper tubes expanded into aluminum fins. Galvanized or polymer drain pan sloped in all directions.

4. Filter: MERV 8, 2-inch thick, pleated, throw-away.

5. Supplemental Heat Coil:

a. Electric Heat Coil: UL Listed with helix wound bare nichrome wire heating elements. Heat output and staging as scheduled. Power usage per stage is not to exceed 5 kilowatts. Staging of coil heat internally controlled.

F. Condensate:

1. Secondary drain pan; condensate overflow shut-off float switch and external alarm.

G. Controls: Factory-wired to internal terminal strip or board for connection to programmable thermostat.

H. Electrical: Furnish magnetic contactors. Arrange for single point electrical connection. Provide all associated field wiring.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Install with required clearances and access for maintenance.

B. Install factory furnished devices for field installation.

C. Inspect for and remove shipping bolts, blocks and tie-down straps.

D. After energizing units: Test units for proper fan rotation. Test and adjust controls and internal safeties. Replace malfunctioning units and retest.

E. Thoroughly clean exposed portions of equipment. Install new filters prior to final test and balance and again prior to final acceptance.

F. Provide vibration isolation: As scheduled.

G. Provide seismic restraint.

H. Condensate drain per manufacturer's piping diagram.

I. Condensate piped to indirect waste connection or exterior of building; cleanouts at changes of direction; sized and sloped to drain per Code. Secondary drain pan with float switch.

END OF SECTION

SECTION 23 82 00

TERMINAL HEAT TRANSFER EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Work Included:

1. Electric Unit Heater

1.02 RELATED SECTIONS

A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

A. Warranty of materials and workmanship as outlined in Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 ELECTRIC UNIT HEATER

A. Manufacturers:

1. Trane
2. Markel
3. Qmark
4. Chromalox
5. Modine
6. Indeeco
7. Reznor

B. Description: Electric unit heater wired internally for single point connection. Horizontal or vertical air delivery, complete with fan, motor, heavy gauge steel casing with adjustable

discharge louvers, mounting bracket, tubular finned heating element, automatic reset thermal overloads, and control circuit transformer. UL listed and wired per NEC.

C. Components:

1. Chassis: Fabricated of 14 gauge cold rolled steel with fan guard.

2. Heating Section: Liquid filled with low watt density immersion type copper sheathed elements hermetically sealed into the core made of steel with aluminum fins. Heat transfer fluid of ethylene glycol solution.

3. Supply Fan: Propeller type with aluminum blades, direct drive.

4. Supply Fan Motor: Permanently lubricated ball bearing type, 1750 RPM, open drip proof, same voltage and phase as heating element.

5. Outlet Grille: 14 gauge steel adjustable louvers with minimum position stops.

6. Mounting: Bracket(s) and appurtenances for wall mounting.

D. Control: Remote thermostat with summer fan switch. 24V control circuit.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways. Check each piece of equipment for defects, verifying that items function properly and that adjustments have been made.

B. Prior to acceptance, thoroughly clean exposed portions of terminal heat transfer equipment, remove shipping labels and traces of foreign substance. Touch up scratched surfaces of radiant panels with factory matching paint.

3.02 ELECTRIC UNIT HEATER INSTALLATION

A. Unit Heaters: Suspend from structure with 5/8-inch diameter rods.

B. Damaged Coils: Make every effort to prevent damage to both built-up coils and coils of packaged equipment. Comb damaged coil fins to be straight.

C. Suspend from structure with 5/8-inch diameter rods and per manufacturer instructions.

D. Install thermostat as shown on drawings. Provide control wiring from thermostat to unit.

END OF SECTION

SECTION 26 01 00

OPERATION AND MAINTENANCE OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Definitions.
2. General requirements.
3. Submittal procedures.
4. Content requirements for manuals.
5. Supplements.

1.02 DEFINITIONS

A. Maintenance Operation.

1. Routine operation required to ensure satisfactory performance and longevity of the equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands and other routine adjustments.

1.03 GENERAL REQUIREMENTS

A. Provide operation and maintenance data for items listed in Supplement 26 01 00 – A, "Schedule of Equipment Requiring Operation and Maintenance Data".

B. In addition to the composite of manuals for individual equipment items or systems, provide a consolidated summary of required routine scheduled maintenance and scheduled preventative and predictive maintenance for the project, with reference to where detailed information may be found. Include safety information and emergency plans and procedures. The summary shall be in a separate binder from the other equipment and system binders.

C. Comply with the following format relating to the Operation and Maintenance Manual:

1. All binders shall be "D" ring type with one-touch ring locking mechanism.
2. Overlay material shall be crystal clear poly.
3. Binders shall be black poly.
4. Binders shall be nominally sized for 75 percent fill per volume with a maximum binder depth of four (4) inches and a minimum depth of one (1) inch.
5. Submit example binder cover sheet for approval by ENGINEER.
6. Submit example spine insert for approval by ENGINEER.
7. Paper: twenty (20) pound minimum, white for typed pages, 8.5 x 11 inches.
8. Text: Manufacturer's printed data, or neatly typewritten. Facsimiles transmitted via fax machine shall be unacceptable.

9. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.

10. Provide fly-leaf for each separate product, or each piece of operating equipment, with typed description of product and major component parts of equipment. Provide with heavy section dividers with numbered plastic index tabs.

11. Provide each manual with a title page, typed table of contents with consecutive page numbers. Plan contents of entire set, identified by volume number, in each binder.

12. Material shall be suitable for reproduction with quality equal to the original. Photocopying of material will be acceptable except for material containing photographs.

13. Table of contents shall be neatly typewritten, arranged in a systematic order, containing as a minimum the following data:

    a. CONTRACTOR, name of responsible principle, address and telephone number.

    b. List of each product required to be included and indexed to content of each volume.

    c. List of each product, name, address and telephone number of subcontractor, supplier, installer and maintenance contractor as appropriate.

    d. Provide local source and phone number of supply for parts and replacement.

    e. Identify each product by product name, model number and other identifying numbers or symbols as set forth in the Contract Documents.

14. Product data:

    a. Include only those sheets that are pertinent to the specific product provided.

    b. Clearly annotate each sheet to identify specific product or part installed, data applicable to the installation and delete references to inapplicable information.

15. Drawings; supplement product data with drawings as necessary to clearly illustrate the following:

    a. Relationship of component parts of equipment and systems.

    b. Control and flow diagrams.

    c. Coordinate drawings with project record documents to assure correct illustration of completed installations.

    d. CONTRACTOR shall not use project record documents as maintenance manual drawings.

    e. Provide reinforced punched binder tabs.

    f. Reduced 11 x 17 inch drawings shall be folded to 8.5 x 11 inch format.

    g. Where reduction to 11 x 17 inch is impractical, fold and place the 8.5 x 11 inch envelopes that are bound in the binder.

h. Identify specification Section and product on drawings and envelopes.

1.04 SUBMITTAL PROCEDURE

A. Compile the required data, arrange as specified herein and insert data in the number of volumes necessary. The volumes shall be submitted as a complete set. Partial or incomplete manuals shall be rejected by the ENGINEER

B. Preliminary Manuals:

1. Submit three copies to ENGINEER for review and approval well before the starting and adjusting activities commence.

2. If accepted:

a. One copy will be returned to the CONTRACTOR.

b. One copy will be forwarded to the OWNER.

c. One copy will be retained in the ENGINEER's file.

3. If rejected:

a. Two copies will be returned to the CONTRACTOR with ENGINEER's comments for revision.

b. One copy will be retained in the ENGINEER's file.

c. CONTRACTOR shall be required to resubmit three revised preliminary manuals for ENGINEER's review.

C. Final Manuals:

1. Submit two copies to ENGINEER for review and approval before final completion.

2. If accepted:

a. CONTRACTOR will be so notified.

b. CONTRACTOR shall provide a complete set of the final manual on CD-ROM. Data written specifically for the manual will be presented in MS Word format. Manufacturer data (per-printed data) will be presented in Adobe PDF format.

3. If rejected:

a. At the ENGINEER's discretion either all but one copy of the manuals will be returned to the CONTRACTOR for revisions or all copies will be retained by the ENGINEER and the necessary revision data will be requested from the CONTRACTOR.

1.05 CONTENT REQUIREMENTS FOR MANUALS

A. The Operation and Maintenance Manuals shall normally consist of no less than four volumes outline below.

B. Volume 1 – Facility Overview.

1. All sheets in volume 1 shall have sheet protectors.

2. All materials in volume 1 shall be copied onto a CD and provided to the ENGINEER.

3. Include instructions and procedures for handling, storage, maintenance during storage, assembly, erection, installation, adjusting, testing, operating, shut down in emergency, troubleshooting, maintenance, interface with other equipment and as may otherwise be required.

4. Organize in a consistent format under separate heading for each different procedure.

5. Provide a logical sequence of instructions for each procedure.

6. Provide an information sheet for the OWNER's personnel which include the proper procedures in the event of a failure and instances that might affect the validity of warranties or bonds.

7. Content for each unit (or common units) and system:

    a. Description of unit and component parts including controls, accessories and appurtenances. Detail their function, normal operating characteristics and limiting conditions. Provide performance curves, engineering data, nameplates data and test forms. Provide a complete commercial number and nomenclature for replaceable parts.

8. Operating Procedures:

    a. Start-up and break-in routine and normal operating instructions.

    b. Test procedures and results of factory tests where required.

    c. Regulation, control, stopping and emergency instructions.

    d. Description of operation sequence by control manufacturer.

    e. Shutdown instructions for both short and extended durations.

    f. Summer and winter operating instructions as applicable.

9. Maintenance and Overhaul Procedures:

    a. Routine operations

    b. Guide to troubleshooting.

    c. Disassembly, removal, repair, reinstallation and reassembly.

10. Installation Instructions including alignment, adjusting, calibrating and checking.

11. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list and diagrams required for maintenance.

12. Parts list by generic title and manufacturer's part number.

13. Name, location and telephone number of nearest supplier and spare parts warehouse.

14. Where applicable identify installed spares and other provisions for future work (e.g. reserved panel space, unused components, wiring and terminals).

15. Manufacturer's printed operating and maintenance instructions.

16. Charts of valve tag numbers along with the location and function of each valve.

17. Manufacturer's certifications including calibration data sheets and specified calibration procedures or methods for installed equipment.

18. Warranty forms and information for all installed equipment provided by the CONTRACTOR.

19. Circuit directories for all panels including electrical, control and communication.

20. List of adjustable electrical relay settings, control and alarm settings.

C. Volume 2 – Equipment Manuals.

1. Table of contents shall have a sheet protector

2. Table of contents and index sheets shall be of colored card stock.

3. Manuals for individual equipment shall not be divided between separate binders.

4. List function, normal operation, characteristics and limiting conditions.

5. Complete commercial part number and nomenclature of replaceable parts.

6. Maintenance procedures including routine operations, guide to troubleshooting and adjustments.

7. Manufacturer's printed operation and maintenance instructions.

8. List of manufacturer's spare parts and recommended quantities to be maintained in storage.

9. Contents for Maintenance Summary Manual:

a. Compile individual maintenance summaries for each applicable equipment item, respective unit or system and for components or subunits.

b. Format shall include use of the Supplement 26 01 00 – B "Maintenance Summary" provided. Each Maintenance Summary may take as many pages as required. Supplement shall be typewritten and shall include detailed lubrication instructions and diagrams showing points to be greased or oiled, recommended type, grade and temperature range of lubricants and frequency of lubrication.

c. Include a list and quantity of manufacturer's recommended consumable and spare parts that should be stored on site.

D. Volume 3 – Drawings

1. As-built drawings associated with the project shall be provided. This includes, but is not limited to, manufacturers supplied drawings. All drawings shall be provided on 11 x 17 inch sheets folded to 8.5 x 11 inch size and bound in this volume. A complete and detailed index shall be provided that includes a list of all drawings in the volume and the drawings shall be tabbed in a fashion that provides clear and concise identification.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 SUPPLEMENTS

A. Supplement 26 01 00 – A, “Schedule of Equipment Requiring Operation and Maintenance Data”.

B. Supplement 26 01 00 – B, “Maintenance Summary Form”.

END OF SECTION

SUPPLEMENT 26 01 00 – A

SCHEDULE OF EQUIPMENT REQUIRING

OPERATION AND MAINTENANCE DATA

Item No.	Section	Manual (M) Data Sheet (D)	Description
1.	26 24 16	D	Panelboards
2.	26 28 16	M	Manual Transfer Switch
3.	26 32 00	M	Generator Assembly
4.	26 51 00	D	Interior Light Fixtures
5.	26 56 00	D	Exterior Light Fixtures
6.	40 71 00	M	Flowmeter & Transmitter
7.	40 72 00	M	Pressure Level Transducer
8.	40 78 00	D	Individual Devices Installed on Local Control Station

END OF SUPPLEMENT

SUPPLEMENT 26 01 00 – B
MAINTENANCE SUMMARY FORM

Project Name:	Project Number:
Equipment:	Equipment ID / Tag Number:
Manufacturer:	Nameplate Data:
Manufacturer's Local Supplier Name:	
Phone:	
Address:	

MAINTENANCE REQUIREMENTS

Maintenance Requirements	Frequency Required	Lubricant if Required

END OF SUPPLEMENT

END OF SECTION

SECTION 26 01 06

STARTING AND ADJUSTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. Definitions.
2. Sequence of start-up activities.
3. General requirements.
4. Manufacturer's representative responsibilities.
5. CONTRACTOR's independent process control test certification verification.
6. CONTRACTOR's demonstration of the process control test certification to the ENGINEER.
7. CONTRACTOR's independent functional test certification verification.
8. CONTRACTOR's demonstration of the functional test certification to the ENGINEER.
9. Record keeping.
10. Supplements.

1.02 DEFINITIONS

A. Manufacturer's Representative – Authorized service division employee of the manufacturer.

1.03 SEQUENCE OF START-UP ACTIVITIES

A. Develop a specific plan for testing and start-up activities required for the project and submit to the ENGINEER for approval no less than 21 days before the initial start-up of equipment begins. The plan shall, as a minimum, incorporate the activities itemized below.

1. Complete all work associated with the installations of the unit and related processes before start-up activities begin.
2. Manufacturer's representative shall certify the installation meets manufacturer's recommendations and instructions.
3. Manufacturer's representative shall certify equipment operates as specified and as shown in the Contract Documents.
4. Calibrate instruments.
5. CONTRACTOR's independent process control test certification verification.

6. CONTRACTOR's demonstration of the process control test certification to the ENGINEER. Operation and maintenance manuals shall be available during this activity.

7. CONTRACTOR's independent functional test certification verification.

8. CONTRACTOR's demonstration of the functional test certification to the ENGINEER.

9. Submit records kept during start-up and adjusting activities.

10. Demonstration and training described in Section 26 01 15 – Demonstration and Training.

11. CONTRACTOR shall provide sufficient time in the progress schedule to accommodate the start-up sequences.

1.04 GENERAL REQUIREMENTS

A. All identification labeling shall be in compliance with Section 26 05 53 Identification of Electrical Systems.

B. Demonstrate proper function of all equipment, systems and control devices.

C. Furnish labor, process medium, chemicals, tools, equipment, instruments, and services required for, and incidental to, completing start-up and adjusting activities.

D. Manufacturer's representative shall provide assistance for assembly and installation as well as testing guidance and troubleshooting during the start-up and adjusting activities.

E. Complete Supplement 26 01 06-A, "Process Control Test Certification" and submit the completed form to the ENGINEER for approval. The submission and approval of this form is required prior to commencing with the CONTRACTOR's demonstration to the ENGINEER that each process itemized in the Process Control Test Certification operates as specified and designed.

F. Complete the following mechanical adjustments prior to, or during, the CONTRACTOR's initial start-up and adjusting activities and before demonstration to the ENGINEER.

1. Remove rust preventatives and oils applied to protect equipment during construction.

2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.

3. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.

4. Remove temporary supports, bracing and other foreign objects installed to prevent damage during shipment, storage and erection.

5. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.

6. Perform cold alignment and hot alignment to manufacturer's tolerances.

7. Adjust belt tension and variable pitch sheaves.

8. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.

9. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.

10. Install gratings, safety chains, handrails, shaft guards and sidewalks prior to operational testing.

G. Complete the following electrical and control adjustments prior to, or during, the CONTRACTOR's initial start-up and adjusting activities and before demonstration to the ENGINEER.

1. Perform insulation resistance tests on all conductors operating at or above 200 volts.

2. Perform continuity tests on all conductors.

3. Test and set circuit breaker relays and circuit breaker trip settings for proper operation. Coordinate the trip settings for all circuit breakers.

4. Check and record motors for actual full load amperage draw on each phase and compare to nameplate value. Submit results to ENGINEER.

H. Complete the following instrumentation adjustments prior to, or during, the CONTRACTOR's initial start-up and adjusting activities and before demonstration to the ENGINEER.

1. Field calibrate instruments and make required adjustments and control point settings.

2. Leak test pneumatic controls and instrument air piping.

3. Energize transmitting and control signal systems, verify proper operations, ranges and settings.

1.05 MANUFACTURER'S REPRESENTATIVE RESPONSIBILITIES

A. Manufacturer's representative shall inspect the installation and certify with a written report that the installation meets the requirements of the Contract Documents as well as the Manufacturer's recommendations. This shall be done before the equipment is energized.

B. At completion of a manufacturer's representatives' start-up and testing activities, they each shall furnish a written report certifying the equipment installation meets the following conditions.

1. Has been properly installed to meet the IBC seismic requirements and has been adjusted, aligned and lubricated as required.

2. Is free of any stresses imposed by connecting piping or anchor bolts.

3. Is suitable for satisfactory full time operation under full load conditions.

4. Operates within the allowable limits for vibration.

5. Controls, protective devices, instrumentation and control panels furnished as part of the equipment package are properly installed, calibrated and functioning.

6. Control logic for start-up, shutdown, sequencing, interlocks and emergency shutdowns have been tested and are functioning properly.

1.06 CONTRACTOR'S INDEPENDENT PROCESS CONTROL TEST CERTIFICATION VERIFICATION

A. Verify the equipment provided is installed correctly and functions properly.

B. Complete Supplement 26 01 06-A, "Process Control Test Certification" pursuant to the following.

1. The supplement is not intended as a replacement for a systematic check of all the requirements specified.

2. Complete the tests outlined in the Supplement, fill out the form and sign it certifying that the tests have been successfully performed and the results recorded.

3. Where it is not possible to test a function without the software furnished, the CONTRACTOR shall verify the inputs/outputs (I/O's) are terminated correctly by simulating the process as closely and to the extent possible and checking the I/O terminations for voltage and continuity.

C. Submission of the completed Supplement to the ENGINEER and approval of the submission are a prerequisite to the CONTRACTOR's demonstration of process control test certification to the ENGINEER.

1.07 CONTRACTOR'S DEMONSTRATION OF PROCESS CONTROL TEST CERTIFICATION TO THE ENGINEER

A. The intent of the demonstration of the operation to the ENGINEER is to ascertain the installation, including the hardwired control, are in compliance with the Contract Documents. Successful completion of this step will facilitate efficient demonstration of the complete operations of the facilities when the configured control software is installed and tested as part of the Functional Test Certification.

B. Demonstrate compliance with the items listed in Supplement 26 01 06-A.

C. ENGINEER may require the CONTRACTOR to demonstrate functions or processes in addition to those itemized in Supplement 26 01 06-A.

D. ENGINEER's approval of the demonstration of the process control test certification is required before the Functional Test Certification phase commences.

1.08 CONTRACTOR'S INDEPENDENT FUNCTIONAL TEST CERTIFICATION VERIFICATION

A. Complete Supplement 26 01 06-B, "Functional Test Certification" pursuant to the following.

1. Complete the tests outlined in the Supplement, fill out the form and sign it certifying that the tests have been successfully performed and the results recorded.

2. This test will be conducted with the configured software installed and functional. Alarms, data logging, trending and control functions shall be verified

B. Submission of the completed Supplement to the ENGINEER and approval of the submission are a prerequisite to the CONTRACTOR's demonstration of functional test certification to the ENGINEER.

1.09 CONTRACTOR'S DEMONSTRATION OF THE FUNCTIONAL TEST CERTIFICATION TO THE ENGINEER

A. The intent of the demonstration of the Functional Test Certification to the ENGINEER is to ascertain the installation, including the configured software program, is in compliance with the Contract Documents.

B. Demonstrate items listed in Supplement 26 01 06-B, "Functional Test Certification" to the ENGINEER.

C. ENGINEER may require the CONTRACTOR to demonstrate functions or processes in addition to those itemized in Supplement 26 01 06-B.

D. ENGINEER's approval of the demonstration of the Functional Test Certification is a prerequisite to beginning the commissioning phase.

1.10 RECORD KEEPING

A. CONTRACTOR shall maintain, as a minimum, the following records generated during the start-up and adjusting activities.

1. Daily logs of equipment and process testing, identifying all tests conducted and a summary of the results.

2. Logs of time spent with manufacturer's representatives providing services for the project.

3. Equipment lubrication records.

4. Electrical phase voltage and amperage measurements for all equipment.

5. Insulation resistance measurements.

6. All completed test forms specified in Section 16080 Electrical Testing.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 SUPPLEMENTS

A. Supplement 26 01 06-A, "Sweet Home Mahler Water Reclamation Facility Process Control Test Certification".

B. Supplement 26 01 06-B, "Sweet Home Mahler Water Reclamation Facility Functional Test Certification".

END OF SECTION

SUPPLEMENT 26 01 06-A
SWEET HOME MAHLER WATER RECLAMATION FACILITY PROCESS CONTROL TEST CERTIFICATION

PROCESS CONTROL TEST CERTIFICATION

#	Description	Pass	Fail	Comments
	All conductors and cables for field devices shall be terminated before commencing this Process Control Test Certification.			
	Service Entrance Equipment (SMSB-1, MSB-1, GEN-1)			
1	Verify generator remote start command is available at GEN-1 from the ATS located in MSB-1.			
2	Verify generator emergency stop is available at GEN-1 from the emergency stop pushbutton located in the Main Electrical/Blower Building (MEB).			
3	Verify active harmonic filter AHF-1 CTs are available at MSB-1.			
4	Verify active harmonic filter AHF-2 CTs are available at MSB-1.			
	Control Panel, CP-300			
5	Verify power is connected to CP-300 from panel PNL-L, circuit 14.			
6	Verify the control panel has a circuit schedule for all fuses.			
7	Verify CP-300 interior has correct labeling and location of control devices.			
8	Verify CP-300 exterior has correct labeling and location of control devices.			
9	Verify the Fiber Optic (FO) cable is installed and operational between MNP-100 and CP-300.			
10	Verify the Ethernet IP signal from network panel NIP-300 to CP-300 is connected properly and able to transmit and receive.			
11	Verify a normally closed (N/C) SPD Fault and verify signal is received at slot 3; input 2.			
12	Verify a normally closed (N/C) PS Fault and verify signal is received at slot 3; input 3.			
14	Verify a normally open (N/C) UPS Fail Alarm available and verify signal is received at digital input 8.			
15	Verify that digital input 9 is a spare. If not, due to revisions, add the appropriate inputs here and test in the same fashion and record results.			
16	Verify a normally open (N/O) ATS on Normal Power and verify signal is received at digital input 10.			
17	Verify a normally open (N/O) ATS on Generator Power and verify signal is received at digital input 11.			

#	Description	Pass	Fail	Comments
18	Verify a normally open (N/C) Generator Pre-Alarm and verify signal is received at digital input 12.			
19	Verify a normally open (N/C) Generator Alarm and verify signal is received at digital input 13.			
20	Verify that digital input 14 is a spare. If not, due to revisions, add the appropriate inputs here and test in the same fashion and record results.			
21	Verify a normally open (N/C) Float High Level Alarm and verify signal is received at digital input 15.			
22	Verify a normally open (N/C) Phase Fail Alarm and verify signal is received at digital input 16.			
23	Verify a normally open (N/C) Float Low Level Alarm and verify signal is received at digital input 17.			
24	Verify a normally open (N/C) Flowmeter Flow Pulse and verify signal is received at digital input 18.			
25	Verify a normally open (N/C) Float Overflow Alarm and verify signal is received at digital input 19.			
26	Verify that digital outputs 0-11 is a spare. If not, due to revisions, add the appropriate inputs here and test in the same fashion and record results.			
27	Verify an analog (4-20mA) input for Wet Well Level Indicator and verify signal is received at PLC Slot 1, Input 0.			
28	Verify an analog (4-20mA) input for Flowmeter Flow Rate and verify signal is received at PLC Slot 1, Input 1.			
29	Verify that analog inputs 2-3 is a spare. If not, due to revisions, add the appropriate inputs here and test in the same fashion and record results.			
30				

END OF SUPPLEMENT

SUPPLEMENT 26 01 06-B
SWEET HOME MAHLER WATER RECLAMATION FACILITY FUNCTIONAL TEST CERTIFICATION

FUNCTIONAL TEST CERTIFICATION

#	Description	Pass	Fail	Comments
	All conductors and cables for field devices shall be terminated before commencing this Process Control Test Certification.			
	Service Entrance Equipment (SMSB-1, MSB-1, GEN-1)			
1	Verify generator remote start command is available at GEN-1 from the ATS located in MSB-1.			
2	Verify generator emergency stop is available at GEN-1 from the emergency stop pushbutton located in the Main Electrical/Blower Building (MEB).			
3	Verify active harmonic filter AHF-1 CTs are available at MSB-1.			
4	Verify active harmonic filter AHF-2 CTs are available at MSB-1.			
	Control Panel, CP-300			
5	Verify power is connected to CP-300 from panel PNL-L, circuit 14.			
6	Verify the control panel has a circuit schedule for all fuses.			
7	Verify CP-300 interior has correct labeling and location of control devices.			
8	Verify CP-300 exterior has correct labeling and location of control devices.			
9	Verify the Fiber Optic (FO) cable is installed and operational between MNP-100 and CP-300.			
10	Verify the Ethernet IP signal from network panel NIP-300 to CP-300 is connected properly and able to transmit and receive.			
11	Simulate a normally closed (N/C) SPD Fault and verify signal is received at slot 3; input 2.			
12	Simulate a normally closed (N/C) PS Fault and verify signal is received at slot 3; input 3.			
14	Simulate a normally open (N/C) UPS Fail Alarm available and verify signal is received at digital input 8.			
15	Verify that digital input 9 is a spare. If not, due to revisions, add the appropriate inputs here and test in the same fashion and record results.			
16	Simulate a normally open (N/O) ATS on Normal Power and verify signal is received at digital input 10.			
17	Simulate a normally open (N/O) ATS on Generator Power and verify signal is received at digital input 11.			

#	Description	Pass	Fail	Comments
18	Simulate a normally open (N/C) Generator Pre-Alarm and verify signal is received at digital input 12.			
19	Simulate a normally open (N/C) Generator Alarm and verify signal is received at digital input 13.			
20	Verify that digital input 14 is a spare. If not, due to revisions, add the appropriate inputs here and test in the same fashion and record results.			
21	Simulate a normally open (N/C) Float High Level Alarm and verify signal is received at digital input 15.			
22	Simulate a normally open (N/C) Phase Fail Alarm and verify signal is received at digital input 16.			
23	Simulate a normally open (N/C) Float Low Level Alarm and verify signal is received at digital input 17.			
24	Simulate a normally open (N/C) Flowmeter Flow Pulse and verify signal is received at digital input 18.			
25	Simulate a normally open (N/C) Float Overflow Alarm and verify signal is received at digital input 19.			
26	Verify that digital outputs 0-11 is a spare. If not, due to revisions, add the appropriate inputs here and test in the same fashion and record results.			
27	Simulate an analog (4-20mA) input for Wet Well Level Indicator and verify signal is received at PLC Slot 1, Input 0.			
28	Simulate an analog (4-20mA) input for Flowmeter Flow Rate and verify signal is received at PLC Slot 1, Input 1.			
29	Verify that analog inputs 2-3 is a spare. If not, due to revisions, add the appropriate inputs here and test in the same fashion and record results.			
30				

#	Description	Pass	Fail	Comments

END OF SUPPLEMENT

SECTION 26 01 08

ELECTRICAL TESTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Electrical and control testing forms and requirements.

1.02 SEQUENCING

A. ENGINEER shall issue written acceptance of the following certifications submitted by the CONTRACTOR before utility power is supplied to conductors, cables, or equipment.

1. Megger Test
2. Continuity Test
3. Calibration Certification Test
4. Motor Insulation Test

B. CONTRACTOR shall verify to ENGINEER that every function of the electrical, measurement, and control systems are operating properly.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 FIELD QUALITY CONTROL

A. Site Tests, Inspection

1. CONTRACTOR shall be responsible to become familiar with the test and certification requirements of the Contract Documents for this project. It is the intent of these requirements that the Work will be systematically checked to verify that the functions required or implied, work properly to insure safety for the personnel, environment, and equipment associated with the Work.
2. CONTRACTOR shall complete the certification forms that are supplemental to this section and submit the forms to ENGINEER for approval.
3. All site test and inspection certificates and schedules shall be contained in a 3-ring binder(s).
    a. Size 8½ inches by 11 inches.
    b. Paper: 20-pound minimum, white for typed pages.
    c. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
    d. Provide each manual with title page to include “Process Electrical Testing”, typed table of contents with consecutive page numbers. Where more than one binder is used, consecutively title each with a volume

number. The first binder shall be labeled Volume 1 and consecutively numbered as required to include all test documentation.

e. Tab sections for each required section of testing and acceptance certification.

4. CONTRACTOR shall notify ENGINEER seven days in advance of scheduled testing and facilitate the witnessing of those tests by ENGINEER.

5. CONTRACTOR shall provide ENGINEER with current as-built documentation for electrical and measurement and control commissioning with submittal of test certification.

a. Systems operating at or above 200-volts to ground or more shall be included in the Megger Test Certification. Minimum duration for each test shall be one minute, at 1000 VDC, and minimum acceptable results shall be 50 mega ohms.

b. Conductors and cables shall be included in the Continuity Test Certification. No continuity to ground is the only acceptable result of the test.

c. Conductors, cables, or equipment failing to meet the minimum requirements shall be replaced with new. Repair will not be acceptable.

d. Each individual instrument shall have an Instrument Calibration Certificate. The calibration shall operate within the tolerances specified by the manufacturer of the instrument and the Contract Documents.

e. Installed motors shall have a written Motor Insulation Certificate for all the motors listed in the Drawings for the Work. Motors failing test shall be tagged and locked out from operation.

3.02 SUPPLEMENTS

A. Schedule 26 01 08 - A; Megger Test Certificate.

B. Schedule 26 01 08 - B; Continuity Test Certificate

C. Schedule 26 01 08 - C; Instrument Calibration Certificate.

D. Schedule 26 01 08 - D; Motor Insulation Test Certificate.

END OF SECTION

SUPPLEMENT 26 01 08- A
MEGGER TEST CERTIFICATE

		Project Number:
Test Equipment Manufacturer:	Model Number:	Project Name:
Test Equipment Last Calibration Date:	Serial Number:	Accepted By: Date:
Testing Personnel:	Calibration Certificate	Drawing Reference:
Test Voltage:	Test Date:	Title:
		Tag:

Title	Tag Identification	A-Ø/ B-Ø	A- Ø / C- Ø	A- Ø / Ground	B- Ø / Ground	C- Ø / Ground	A- Ø / Neutral	B- Ø / Neutral	C- Ø / Neutral

SUPPLEMENT 26 01 08 – A
MEGGER TEST CERTIFICATE

		Project Number: *12345*
Test Equipment Manufacturer: *APC*	Model Number: *GH-1*	Project Name: *Water Diversion*
Test Equipment Last Calibration Date: *8/13/02*	Serial Number: *346321*	Accepted By: *S.E. Davis* Date: *01/01/2003*
Testing Personnel: *John Doe*	Calibration Certificate: *Yes*	Drawing Reference: *E-006*
Test Voltage: *1000 Volts*	Test Date: *12/17/02*	Title: *Power Distribution Diagram*
		Tag: *016*

SAMPLE

Title	Tag Identification	A-Ø/ B-Ø	A- Ø / C- Ø	A- Ø / Ground	B- Ø / Ground	C- Ø / Ground	A- Ø / Neutral	B- Ø / Neutral	C- Ø / Neutral
Main Feeder	*016-CO3*	∞	∞	∞	∞	∞	∞	∞	∞
PNL-07	*016-CO7*	∞	∞	∞	∞	∞	∞	∞	∞
PNL-12	*016-C12*	∞	∞	∞	∞	∞	∞	∞	∞

END OF SUPPLEMENT

SUPPLEMENT 26 01 08 – B
CONTINUITY TEST CERTIFICATE

		Project Number:
Test Equipment Manufacturer:	Model Number:	Project Name:
Test Equipment Last Calibration Date:	Serial Number:	Accepted By: Date:
Testing Personnel:	Calibration Certificate:	Drawing Reference:
	Test Date:	Title:
		Tag:

Permanent Tag Number	Function	Temporary Tag Number	Device ID Number	Ohms to Ground

SUPPLEMENT 26 01 08 – B
CONTINUITY TEST CERTIFICATE

		Project Number: *12345*
Test Equipment Manufacturer: *Fluke*	Model Number: *53G*	Project Name: *Water Division*
Test Equipment Last Calibration Date: *Unknown*	Serial Number: *638842*	Accepted By: *S.E. Davis* Date: *01/01/2003*
Testing Personnel: *John Doe*	Calibration Certificate: *No*	Drawing Reference: *E-501*
	Test Date: *12/30/02*	Title: *Conduit Schedule*

Permanent Tag Number	Function	Temporary Tag Number	Device ID Number	Ohms to Ground
016-34-PNL	*Level Indicator*	*34*	*016-34*	∞

SAMPLE

END OF SUPPLEMENT

SUPPLEMENT 26 01 08 – C
INSTRUMENT CALIBRATION CERTIFICATE

Component:			Manufacturer:			Project Number:						
Name:			Name:			Project Name:						
			Model:									
☐ Analog						☐ Digital						
	Range	Value	Units	Computing Functions? ☐Y ☐N		Control? ☐Y ☐N Action? ☐Direct ☐Reverse						
Indicate? ☐Y ☐N	Chart:			Describe:								
Record? ☐Y ☐N	Scale:					Switch? ☐Y ☐N Unit Range: Differential: ☐Fixed ☐Adjustable Rest? ☐Automatic ☐Manual						
Transmit? ☐Y ☐N	Input:											
Convert? ☐Y ☐N	Output:											
Required			As Calibrated				Required			As Calibrated		
Input %	Indicated	Output	Increasing input		Decreasing Input		#	Trip Pt	Reset Pt	Trip Pt	Reset Pt	
			Indicated	Output	Indicated	Output		(Note Rising or Falling)		(Note Rising or Falling)		
							1					
							2					

#	Notes: Describe Test Results/List Any Failed Components	Instrument Calibration Acceptance
		By:
		Date:
		☐ Accepted ☐ Rejected
		Loop Title:
		Loop Number:

SUPPLEMENT 26 01 08 – C
INSTRUMENT CALIBRATION CERTIFICATE

Component: *FIT & FE-200*				Manufacturer: *Rosemount*					Project Number: *12345*				
Name: *Main Line Flow Meter*				Name: *Magnetic Flow Meter*					Project Name: *Water Diversion*				
				Model: *53H*									
☐ Analog									☐ Digital				
	Range	Value	Units	Computing Functions? ☐Y ☐N					Control? ☐Y ☐N				
Indicate? ☐Y ☐ N	Chart: *0-400*	GPM		Describe:					Action? ☐Direct ☐Reverse				
Record? ☐Y ☐ N	Scale: *N/A*								Switch? ☐Y ☐N				
Transmit? ☐Y ☐N	Input: *4-20*	MA							Unit Range: 0-400 GPM				
Convert? ☐Y ☐N	Output: N/A								Differential: ☐Fixed ☐Adjustable				
									Rest? ☐Automatic ☐Manual				
Required			As Calibrated						Required			As Calibrated	
Input %	Indicated	Output	Increasing input		Decreasing Input				#	Trip Pt	Reset Pt	Trip Pt	Reset Pt
0	*0 GPM*	*4 mA*	*Indicated*	*Output*	*Indicated*	*Output*				(Note Rising or Falling)		(Note Rising or Falling)	
25	*100 GPM*	*8mA*	*100 GPM*	*8mA*	*101 GPM*	*8.05mA*			1	*N/A*	*N/A*	*N/A*	*N/A*

#	Notes: Describe Test Results/List Any Failed Components	Instrument Calibration Acceptance
		By: *S.E. Davis*
		Date: *12/16/02*
		☐ Accepted ☐ Rejected
		Drawing Reference: *I-802*
		Loop Title: *Flowmeter*
		Loop Number: *016 FIT-200*

SAMPLE

END OF SUPPLEMENT

SUPPLEMENT 26 01 08 – D
MOTOR INSULATION TEST

		Project Number:
Test Equipment Manufacturer:	Model Number:	Project Name:
Test Equipment Last Calibration Date:	Serial Number:	Accepted By: Date:
Testing Personnel:	Calibration:	Drawing Reference:
	Test Date:	

Motor Serial #	Equipment ID #	T-Lead #1/Ground	T-Lead #2/Ground	T-Lead #3/Ground

SUPPLEMENT 26 01 08 – D
MOTOR INSULATION TEST

		Project Number: *12345*
Test Equipment Manufacturer: *APC*	Model Number: *GH-1*	Project Name: *Water Diversion*
Test Equipment Last Calibration Date: *11/3/02*	Serial Number: *346321*	Accepted By: *S.E. Davis* Date: *1/1/03*
Testing Personnel: *John Doe*	Calibration: *Yes*	Drawing Reference: *E-202*
	Test Date: *12/20/02*	

SAMPLE

Motor Serial #	Equipment ID #	T-Lead #1/Ground	T-Lead #2/Ground	T-Lead #3/Ground
GE - 346332	*Sewage pump No. 1*	∞	∞	∞
GE - 346331	*Sewage pump No.2*	∞	∞	∞
GE - 346330	*Sewage pump No. 3*	∞	∞	∞
GE - 346333	*RAS pump No. 1*	∞	∞	∞
GE - 346334	*RAS pump No. 2*	∞	∞	∞

END OF SUPPLEMENT

END OF SECTION

SECTION 26 01 15

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. Definitions.
2. General Requirements.
3. Supplements.

1.02 DEFINITIONS

A. Training Requirements.

1. The following topics shall be covered at a minimum:
   a. Equipment schematics.
   b. Control strategy.
   c. Troubleshooting procedures.
   d. Recommended maintenance and periodic testing procedures.
   e. Advanced start-up procedures.
   f. Control Input/Output (I/O) and communications review.
   g. Operator Interface Terminals (OIT) operating characteristics and navigation between various screens and functions.
   h. Proper use and function of selector switches, reset buttons, speed controls, E-stops, etc.
2. Training shall require one session for each type of process equipment.

B. Manufacturer's Representative / Factory Trained Technician.

1. Shall be an authorized service division employee of the manufacturer.

1.03 GENERAL REQUIREMENTS

A. Provide training for OWNER's personnel for items listed in Supplement 26 01 15 – A, "Schedule of Equipment Requiring Demonstration And Training".

B. Utilize Manufacturer's Representative to conduct training sessions.

C. CONTRACTOR shall have an employee familiar with the details of the installation attend the training sessions.

D. The Manufacturer's Representative and CONTRACTOR shall provided the demonstration and training required to meet the performance specified herein. No costs in addition to the original Bid shall be incurred by the OWNER to meet this requirement.

E. Schedule and coordinate training sessions to accommodate the following:

1. Provide fourteen (14) day written notice to the ENGINEER for approval prior to proposed training sessions.

2. Do not schedule training sessions for Monday, Friday, Saturday, Sunday or a Holiday.

3. No more than two (2) different types of equipment training sessions shall be scheduled for any one (1) day.

4. The Manufacturer's Representative shall utilize the operation and maintenance manuals as a basis for instruction. Should the need for additional data become apparent during instruction, CONTRACTOR shall prepare and insert the additional data into the operation and maintenance manual within seven (7) business days.

5. OWNER reserves the right to video tape the training session. The OWNER agrees that the video tape shall only be used for training employees.

6. Provide the material, data, and training aids including, but not limited to, the copying of any documents, screens, viewers, etc. required for training session.

7. Provide an outline of the topics for discussion during the training session and copies of the operation and maintenance manuals for all training session participants.

8. OWNER will provide the CONTRACTOR with the number of participants at each training session seven (7) days after receipt of the proposed training session schedule.

F. ENGINEER shall not authorize the commencement of the demonstration and training sessions until after successful demonstration of the Functional Test Certification, approval of the test reports submitted from Section 26 01 08 – Electrical Testing and the successful demonstration of the Process Test Certification in Section 26 01 06 – Starting And Adjusting.

G. Should the CONTRACTOR fail to meet the scheduled training session date, OWNER shall be entitled to notification of a new date complying with the requirements indicated herein.

H. Training sessions shall be scheduled to allow for appropriate progression of the training material. If knowledge of certain equipment is necessary to adequately comprehend the operational and maintenance aspects of another piece of equipment, the training session shall be scheduled to provide for this requirement.

I. Training sessions shall meet the following general requirements:

1. Training sessions shall be completed before commissioning.

2. CONTRACTOR shall provide the labor, process medium, chemical, tools, equipment and instruments necessary to accommodate demonstration of the equipment. CONTRACTOR may not rely on adequate water, wastewater, storm water or other normal process flows, etc. as they may not be available.

3. The content of the training sessions shall be specific to the products installed.

4. The training sessions shall be developed to allow for appropriate presentation of information and hands-on operation and maintenance opportunities for the OWNER's staff.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 SUPPLEMENTS

A. Supplement 26 01 15 - A, "Schedule of Equipment Requiring Demonstration And Training".

END OF SECTION

SUPPLEMENT 26 01 15 – A

SCHEDULE OF EQUIPMENT REQUIRING

DEMONSTRATION AND TRAINING

Item No.	Section No.	Description
1	26 24 16	Panelboards
2	26 28 16	Manual Transfer Switch
3	26 32 00	Generator Assembly
4	26 51 00	Interior Light Fixtures
5	26 56 00	Exterior Light Fixtures
6	40 71 00	Flowmeter & Transmitter
7	40 72 00	Pressure Level Transducer
8	40 78 00	Individual Devices Installed on Local Control Station
		OTHER ITEMS AS MAY BE SPECIFIED IN INDIVIDUAL SECTIONS.

END OF SUPPLEMENT

END OF SECTION

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 PERMITS, FEES AND SERVICE CHARGES

A. The CONTRACTOR shall obtain all electrical permits required to complete the work and pay all associated fees.

B. The CONTRACTOR shall coordinate and provide for the installation and operation of franchise utility service (including any telephone and/or leased lines specified) as required during construction, startup, testing, and operation of the work until substantial completion.

1.02 OWNER FURNISHED CONTRACTOR INSTALLED EQUIPMENT

A. The following is a list of OWNER FURNISHED CONTRACTOR INSTALLED EQUIPMENT.

Item	Description
Switchboard SMSB-1	Main Service Switchboard
Switchboard MSB-1	Main Distribution Switchboard
MCC-300	Motor Control center
CP-300	PLC Control Panel
NIP-300	Network Panel
MNP-100	Network Panel

1.03 INTENT OF DRAWINGS AND SPECIFICATIONS

A. The contract document drawings and specifications are complimentary. What is called for by one shall be binding as if called for by all. Where a conflict occurs between the drawings and specifications, the stricter of the two shall take precedence.

B. It is the CONTRACTOR'S responsibility to schedule and coordinate the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR'S Work.

C. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only; exercise professional judgment in executing the Work to ensure the best possible installation:

1. The equipment locations and dimensions indicated on the Drawings are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all electrical equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.

2. The CONTRACTOR has the freedom to select any of the named manufacturers as identified in the individual specification sections; however, the ENGINEER has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the CONTRACTOR's responsibility to ensure that the equipment being furnished fits within the defined space.

D. Riser and other diagrams are schematic and are intended to show the approximate location of equipment, and the general alignment of conduits and piping, and shall not be used for obtaining quantities. Dimensions given on the plans shall take precedence over scaled dimensions and all dimensions whether in figures or scaled, shall be verified in the field.

E. The electrical drawings do not show complete details of the site conditions. The CONTRACTOR shall check actual conditions.

F. The exact location of apparatus, fixtures, equipment, conduit and piping shall be ascertained by the CONTRACTOR in the field, and the work shall be laid out accordingly. Should the CONTRACTOR fail to ascertain such locations or coordinate with work performed by other trades, the work shall be changed at no additional cost to the OWNER when so ordered by the ENGINEER. The ENGINEER reserves the right to make minor changes in the location of conduit, piping and equipment up to the time of installation without additional cost to OWNER.

G. CONTRACTOR shall provide all labor, materials, equipment, machinery, and tools necessary to provide all electrical equipment specified and shown on the Drawings. All items not specified in detail or shown on the Drawings but necessary for complete installation shall be provided by the CONTRACTOR.

H. Schematic diagrams:

1. All controls are shown de-energized.

2. Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.

3. Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.

4. Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.

5. Schematic diagrams are to be used in conjunction with the descriptive operating sequences in the Contract Documents. Combine all information and furnish a coordinated and fully functional control system.

1.04 CONTRACTOR'S RESPONSIBILITY FOR FIELD VERIFICATION OF EXISTING CONDITIONS

A. The CONTRACTOR shall be responsible for performing field verification of the existing conditions prior to bidding. The nature of this work inherently requires field observation to understand the existing conditions and scope of work.

B. Failure to observe the existing conditions or ignorance of existing conditions shall the responsibility of the CONTRACTOR alone. Additional services shall not be authorized due to the CONTRACTOR'S lack of understanding of the existing conditions.

1.05 CONTRACTOR'S RESPONSIBILITY FOR SHUTDOWNS AND MAINTAINING EXISTING SYSTEMS

A. Shutdowns of any Division 26 or 40 system shall be coordinated with the OWNER prior to performing the shutdown. The CONTRACTOR shall provide the OWNER with a written schedule identifying the system, duration, and impact on the OWNER's facility.

B. Existing Division 26 or 40 systems not impacted by the work in this project shall be protected and maintained during construction. Any system not identified on the Drawings or within these Specifications shall be brought immediately to the attention of the ENGINEER and OWNER.

C. The CONTRACTOR shall be responsible for bearing the cost of repairing or restoring all electrical systems that are disrupted or damaged during construction. The systems shall be repaired and restored to their original condition.

1.06 SUBSTITUTION REQUESTS FOR MECHANICAL, HVAC, PROCESS, OR OTHER EQUIPMENT IMPACTING THE ELECTRICAL DESIGN

A. The CONTRACTOR shall be responsible for including the cost impact to the electrical systems for substitution requests and/or value engineering for mechanical, HVAC, process, or other equipment made by other trades. The costs to the overall substitution request or value engineering solution must be included in the total number provided to the OWNER. The CONTRACTOR is responsible for coordinating the substitution requests or value engineering proposals made by other trades.

B. Any substitution request and/or value engineering solution which impacts the electrical design but does not include the costs shall be unacceptable.

C. Failure of other subcontractors to include the electrical cost impact shall not be the basis for a change order. The CONTRACTOR shall be responsible for coordinating the total costs of all substitution requests and/or value engineering solutions prior to presenting them to the ENGINEER or OWNER. When these requests are received by the ENGINEER or OWNER to review and approve, the ENGINEER and OWNER shall assume the cost impact to electrical has been included.

1.07 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example – 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they

are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Submittals shall be in accordance with the requirements of these Contract Documents and shall include the following:

1. Submittals shall include information and literature as required for all equipment and materials provided under this and related sections.

2. Shop Drawings: Shop drawings shall include the following along with any special requirements listed in the individual Specification Sections:

   a. Installation instructions and drawings

   b. Wiring schematics with termination point identification

   c. Motor information

   d. Materials of construction

   e. Manufacturer's name and model

   f. Manufacturer's catalog data

   g. Supplementary structural framing for electrical equipment including design loads, member size and location. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.

3. Manufacturers' Literature: Literature indicating the compliance of the products with the Specifications shall be included with all submittals. This shall include catalogs and other descriptive bulletins. Relevant portions of the literature shall be clearly identified by highlighting or underlining.

4. Test Logs: The CONTRACTOR shall submit test logs as outlined below and as specified in subsequent electrical sections and drawings.

   a. A log of the complete results of tests for shorts and grounds for each circuit. All circuits and tests shall be clearly identified.

   b. A log of complete results of insulation resistance measurements of each circuit. All circuits and tests shall be clearly identified.

5. Operation and maintenance information for all equipment furnished and/or installed.

6. Programming instructions for any controllers or other programmable equipment. Copies of the any required software, including registration cards, shall be provided with the O&M manuals.

D. The CONTRACTOR shall indicate on the submittals all variances from the Specifications.

E. Record Drawings. After the completion of construction, the CONTRACTOR shall provide one set of "as-built" drawings to the ENGINEER as specified herein showing the location of buried conduits and all changes or deviations from the original drawings.

F. After the completion of construction, a printout and electronic copy of any programming and/or set-points for controllers, PLCs, meters or other programmable equipment, including VFDs.

G. Final inspection certificates shall be submitted prior to final payment.

1.08 INTERFACES TO EQUIPMENT, INSTRUMENTS, AND OTHER COMPONENTS:

A. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.

B. Provide all material and labor needed to install the actual equipment furnished, and include all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the Work, which may be necessary to make a complete, functional installation based on the actual equipment furnished:

1. Make all changes necessary to meet the manufacturer's wiring requirements.

C. All electrical equipment and systems for the entire Project must comply with the requirements of the Electrical Specifications, whether referenced in the individual Equipment Specifications or not:

1. The requirements of the Electrical Specifications apply to all Electrical Work specified in other sections, including HVAC controls, packaged mechanical systems, LCPs, VCPs, etc.

2. Inform all vendors supplying electrical equipment or systems of the requirements of the Electrical Specifications.

3. The Owner is not responsible for any additional costs due to the failure of the Contractor to notify all subcontractors and suppliers of the Electrical Specifications requirements.

D. Special subcontractor requirements:

1. As specified elsewhere in this Section, provide the Work specified in the Electrical Specifications by a qualified electrical subcontractor.

1.09 COORDINATION OF WORK

A. The CONTRACTOR shall plan his work in coordination with the other trades and with the power and telephone utility authorities.

B. The CONTRACTOR shall field verify all dimensions of equipment to be installed or provided by others so that correct clearances and connections may be made between the work installed by the CONTRACTOR and equipment installed or provided by others.

C. The CONTRACTOR shall arrange all conduit runs so that they do not interfere with piping, structural members, etc.

D. All working measurements shall be taken from the sites, checked with those shown on the drawings, and if they conflict, reported to the ENGINEER at once, and before proceeding with the work. Should the CONTRACTOR fail to comply with this procedure, he shall alter his work at his own expense as directed by the ENGINEER.

E. No additional payments will be allowed where obstructions in the work of other trades, or work under this contract requires offsets to conduit runs.

F. The CONTRACTOR is responsible for all alterations in the work to accommodate equipment differing in dimensions or other characteristics from that shown or specified.

G. The CONTRACTOR shall provide all temporary power necessary for existing site equipment and for all construction needs.

1.10 SUPERVISION

A. The CONTRACTOR shall maintain adequate supervision of the work and shall have a responsible person in charge at the site during all times that work under this contract is in progress, or when necessary for coordination with other work.

1.11 CODES

A. Work shall conform to the National Electrical Code (NEC), and State Codes and other applicable codes, even though not specifically mentioned for each item. These shall be regarded as the minimum standard of quality for materials and workmanship.

1.12 QUALITY ASSURANCE

A. System supplier responsibilities:

1. Requirements as specified in the Instrumentation and Control Specifications.

2. System supplier:

a. Due to the critical and complex technical requirements of this Project, all Work (materials, equipment, products, submittals, labor, services, etc.) specified in the Electrical, and Instrumentation and Control Specifications, and shown on the Electrical and Instrumentation Drawings is to be furnished by a single system supplier who has single source responsibility for both the process control and instrumentation systems and the electrical power system.

3. Contractual relationship:

a. Form a contractual relationship between the electrical subcontractor and the Instrumentation and Control Subcontractor (ICSC).

b. Requirements for the first-tier subcontractor:

1) Contract directly with the Contractor.

2) Be either the electrical subcontractor or the ICSC.

c. Requirements for the second-tier subcontractor:

1) A division of the first-tier subcontractor, or

2) A joint venture with the first-tier subcontractor, or

3) A subcontractor to the first-tier subcontractor.

d. The system supplier manages, directs, and supervises all the Work of its second-tier subcontractor. The system supplier is solely responsible for the entire electrical and instrumentation system, including, but not limited to, all Electrical, Instrumentation, and Process Contract Drawings, Electrical Specifications, and Instrumentation and Control Specifications:

1) Provide any additional conduit, wire, etc.

2) Any additional I/O, programming, screens, interface devices needed by the system supplier are to be provided by the electrical subcontractor or the ICSC, under the above outlined working agreement.

3) Ensure compatibility between the Process Control and Instrumentation System (PCIS) and the electrical system being installed.

1.13 SITE OR PROJECT CONDITIONS

A. Provide enclosures for electrical, instrumentation and control equipment, regardless of supplier or subcontractor furnishing the equipment, that meet the requirements outlined in NEMA Standard 250 for the following types of enclosures:

1. NEMA Type 1: Intended for indoor use, primarily to provide a degree of protection from accidental contact with energized parts or equipment.

2. NEMA Type 4: Intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing.

3. NEMA Type 4X: Made from corrosion resistant materials (316 stainless steel) and are intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing, and corrosion.

4. NEMA Type 12: Intended for indoor use, primarily to provide a degree of protection from dust, falling dirt and dripping non-corrosive liquids.

5. NEMA Type 6: Rated for submergence.

6. NEMA Type 6P: Rated for prolonged submergence.

7. NEMA Type 7: Intended for installation in locations where explosive or combustible gas or vapors may be present (Class I Division 1 or Class I Division 2) meeting the requirements outlined in Section 26 05 08.

8. NEMA Type 8: Intended for installation in either indoor or outdoor locations where explosive or combustible gas or vapors may be present (Class I Division 1 or Class I Division 2) and the equipment is oil-immersed, meeting the requirements outlined in Section 26 05 08.

B. Plant Area Electrical Work Requirements:

1. Provide all Electrical Work in accordance with the following table, unless otherwise specifically indicated on the Drawings:

2. Provide stainless steel NEMA 4X enclosures and supports, and PVC-GRC conduit type for all Electrical work not included in the following table unless otherwise indicated on the Drawings. Conduit type definitions are listed under 26 05 33, Part 1.03B.

3. Reference Section 26 05 29 – Hangers and Supports and 26 05 33 – Raceway and Boxes for detailed requirements.

Plant Area	NEMA Enclosure Type	Exposed Conduit Type	Environment (1)	Support Materials & Hardware	Anchor Materials
Main Electrical Building, Blower Building Exterior	NEMA 4X	RAC	W	SST	SST
Main Electrical Building, Blower Building Interior	NEMA 12	EMT	D	Galvanized	Galvanized
Existing Electrical Building Exterior Exposed	NEMA 4X	RAC	W	SST	SST
Existing Electrical Building Exterior Interior	NEMA 12	EMT	D	Galvanized	Galvanized
Underground	NA	PVC 40	W	NA	NA
Conduit Transition from below Grade to Above Grade	NA	PVC-GRC	W	SST	SST
Influent Pump Station	NEMA 4X	PVC-GRC	W, H	SST	SST
(1) W = WET; D = DAMP; C = CLEAN/DRY; X = CORROSIVE; H = HAZARDOUS					

1.14 WIRING WITHIN CONDUIT

A. All wiring shall be installed within a conduit, raceway, or tray as identified within Contract Documents, no exceptions.

1. All wiring associated with low voltage systems, including, but not limited to low voltage communications, electronic access control, building automation / HVAC control, security systems, and fire alarm systems shall be in conduit, no exceptions.

2. All Class II wiring shall be within conduit, no exceptions.

1.15 CONTRACTOR'S RECORD DRAWINGS & AS-BUILTS

A. The CONTRACTOR shall maintain a neatly marked set of record drawings showing the locations of all buried conduits and other utilities encountered or installed during construction. The final locations of panels, field mounted instruments and panels, terminal boxes, junction boxes, receptacles, light switches and other materials included in the work shall be shown, as well as conduit routing between them to the extent it differs from the design drawings. Record drawings shall be kept current with the work as it progresses and shall be subject to inspection by the OWNER's Representative at any time. Failure to keep field record drawings current may result in the issuance of a stop work order or delay in the processing of pay requests until the record drawings are made current.

B. The CONTRACTOR shall provide one complete set of as-built electrical schematics for all panels and equipment provided, including PLC I/O schematics as applicable, panel elementary diagrams, interconnecting wiring diagrams, wire numbers, termination strip locations and numbers. These shall be in the same format and style as those in the Contract Documents and submittal requirements.

C. All information shown on the CONTRACTOR's field record drawings and as-built schematics shall be subject to verification by the OWNER's Representative. If significant errors or deviations are noted by the OWNER's Representative, new as-builts shall be completed at the CONTRACTOR's expense.

PART 2 - PRODUCTS

2.01 PORTABLE OR DETACHABLE PARTS

A. The CONTRACTOR shall retain in his possession and shall be responsible for all portable and detachable parts or portions of installations such as fuses, key locks, adapters, blocking chips and inserts until completion of his work.

B. These parts shall be delivered to the ENGINEER and an itemized receipt obtained. This receipt, together with 2 copies of the final inspection certificate, shall be attached to the CONTRACTOR's request for final payment.

C. All equipment shall be demonstrated to operate in accordance with the requirements of this specification and the manufacturer's recommendations.

2.02 NEW PRODUCTS

A. All products shall be new without defects and covered by Manufacturer's warranty. Products shall be re-used only where indicated on the Drawings.

B. All products shall be listed, labeled, and certified by a testing agency approved by the state of Oregon.

C. All equipment of the same type and capacity shall be by the same manufacturer.

PART 3 - EXECUTION

3.01 IDENTIFICATION

A. All identification labeling shall be in compliance with Section 26 05 53 Identification for Electrical Systems.

3.02 WORKMANSHIP & COORDINATION

A. All work shall be performed by personnel skilled in the particular trade in a workmanlike manner. Workmanship shall conform to the standards of the NEC and the National Electrical Installation Standards (NEIS).

B. The ENGINEER shall be the sole judge as to whether or not the finished work is satisfactory; and if in his judgment any material or equipment has not been properly installed or finished, the CONTRACTOR shall replace the material or equipment whenever required, and reinstall it in a manner entirely satisfactory to the ENGINEER without any increase in cost to the OWNER.

C. The CONTRACTOR shall coordinate and verify the installation of all equipment furnished by him to other trades, or equipment provided and installed by other trades that is connected to the electrical or control systems. Work shall include the furnishing of all labor, materials, and equipment required for the installation of a complete and operable system as hereinafter specified and as indicated on the drawings. The Contract Documents are complementary and what is called for by any one shall be as binding as if called for by all. Unless otherwise specifically stipulated, the term "furnished and installed complete" shall be considered a part of this section.

D. Controls and systems shall be complete with transformers, switches, relays, contactors, control valves, control devices, instrument piping, fittings, valves, control wiring, thermometers, pressure gauges, thermostats, damper operators, miscellaneous control cabinets to fill the intent of the Specifications and shall provide control for the various units and systems. All control valves and motorized dampers shall be provided with position indicators.

E. Unless otherwise specified or shown on the drawings, switches or relays shall be installed in, or adjacent to the motor starter or other electrical device to which they are to be connected. Control and interlock wiring shall be included as necessary from breakers specified herein or shown on the drawings.

F. Each control schematic intended to control a series of motor operated louvers, fans, and thermostats shall contain a switch for maintenance to meet the NEC requirements regarding disconnect switches for motors. This switch shall be local if any unit controlled is out of sight of the switch. This switch shall disconnect all power to all motor operated devices within the circuit.

3.03 TEMPORARY HEATING, LIGHTING AND POWER

A. The CONTRACTOR shall provide all heat, lighting and power required to construct and protect the work until the work is placed in service by the OWNER for beneficial use of the OWNER. Temporary heaters shall be provided as required to keep the work area and all new electrical components dry.

B. The source for temporary power shall be from the electric utility or OWNER approved CONTRACTOR supplied auxiliary power units. The installation for electric power shall meet the requirements of local authorities and of OSHA.

C. The CONTRACTOR shall obtain all permits and pay all costs for connecting temporary power service at no expense to the OWNER.

3.04 SUPPORT BACKING

A. Provide any necessary backing required to properly support all fixtures and equipment installed under this contract.

3.05 CUTTING, PATCHING AND FRAMING

A. The CONTRACTOR shall determine in advance the locations and sizes of all sleeves, chases, and openings necessary for the proper installation of his work.

B. Whenever practical, inserts or sleeves shall be installed prior to covering work. Cutting and patching shall be held to a minimum. All required holes in concrete construction shall be made with a core drill and patched with non-metallic non-shrink grout.

C. Cutting, fitting repairing and finishing of carpentry work, metal work, or concrete work, and the like, which may be required for this work shall be done by craftsmen skilled in their respective trades. When cutting is required, it shall be done in such a manner as not to weaken walls, partitions, or floors; and holes required to be cut in floors must be drilled without breaking out around the holes.

3.06 TESTS

A. The CONTRACTOR shall furnish all labor, material, instruments and tools to make all connections for testing of the electrical and instrumentation installation. All equipment shall be demonstrated as operating properly prior to the acceptance of the work. All protective devices shall be operative during testing of equipment. The tests shall be made under the supervision of the ENGINEER. All deficiencies or unsatisfactory conditions as determined by the ENGINEER or inspecting authorities shall be corrected by the CONTRACTOR in a satisfactory manner at his own expense.

B. After visual inspection of joints and connections and the application of tape and other insulating materials, all sections of the entire wiring system shall be thoroughly tested for shorts and grounds. A log of results for each circuit shall be kept by the CONTRACTOR and presented to the ENGINEER.

C. A phase rotation check shall be made to demonstrate that all power receptacles, service feeders, main power feeders and auxiliary power generators have the same A - B - C phase rotation and ground relationships.

D. Equipment shall be tested by operating all electric motors, relays, controls, switches, heaters, etc., sufficiently to demonstrate proper installation and electrical connections. Control and emergency conditions shall be artificially simulated where necessary for complete system or subsystem.

3.07 CLEANING AND TOUCH-UP PAINT

A. Upon completion of work, all electrical equipment shall be cleaned.

1. Vacuum all dirt, metal shavings, and foreign materials from all enclosures. The use of compressed air shall not be acceptable.

2. All stains, dirt, and fingerprints shall be removed from switchboards, motor control centers, panelboards, light fixtures, enclosures, and all other electrical equipment covers.

B. Provide touch-up paint on equipment that has been scraped, scratched, or chipped during construction. Paint color shall match color of equipment.

3.08 COORDINATION OF STARTUP AND ADJUSTING, COMMISSIONING, DEMONSTRATION AND TRAINING, AND OPERATION AND MAINTENANCE DATA.

A. Reference Section 26 01 00 - Operation and Maintenance Data, and 26 01 15 - Demonstration and Training, 26 01 06 - Starting and Adjusting, and 26 08 00 – Commissioning of Electrical Systems for detailed requirements.

END OF SECTION

SECTION 26 05 05

SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. Removal of existing electrical equipment, wiring and conduit in areas to be remodeled. Removal of designated construction, dismantling, cutting and alterations for completion of the Work.
2. Disposal of materials.
3. Storage of removed materials.
4. Identification of utilities.
5. Salvaged items.
6. Protection of items to remain as identified in the schedules at the end of this Section.
7. Relocate existing equipment.
8. Removal of temporary electrical equipment prior to completion of the Work.

1.02 CLOSEOUT SUBMITTALS

A. Refer to the Contract Documents for general closeout submittal requirements.

B. Project Record Drawings shall be provided that record actual locations of capped conduits and equipment abandoned in place.

1.03 SEQUENCING

A. Sequencing of the Work shall be as noted in the Contract Documents.

1.04 SCHEDULING

A. Refer to the Contract Documents.

B. Coordinate the schedule of noisy, malodorous and dusty work with the ENGINEER.

1.05 COORDINATION

A. Refer to Contract Documents.

B. Conduct demolition to minimize interference with adjacent or occupied areas.

C. Coordinate demolition work with other trades.

D. Coordinate and sequence demolition so as not to cause shutdown or interruption of operation of surrounding areas.

E. Arrange timing of shutdowns with the OWNER. Do not shutdown any utility service without prior written approval. Keep shutdown periods to a minimum.

F. Identify salvage items in cooperation with the OWNER.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify wiring and equipment scheduled for demolition serve only abandoned process and facilities.

B. Verify termination points for demolished services.

3.02 DEMOLITION

A. Items scheduled for demolition shall be legally disposed of by the CONTRACTOR.

B. Remove exposed abandoned conduit.

C. Disconnect electrical systems in walls, floors and ceilings scheduled for removal.

D. Reconnect equipment being disturbed by renovation work and required for continued service.

E. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, switches, receptacles, conduit, and conductors which are not part of the completed project.

F. Install temporary wiring and connections necessary to maintain existing systems in service during construction.

G. Remove, relocate and extend existing installations to accommodate new construction.

H. Repair adjacent construction and finishes to original condition that are damaged during demolition and extension work.

I. Remove abandoned grounding and bonding components, fasteners, supports and electrical identification components. Cut embedded support elements flush with wall, floors and ceilings.

J. Clean and repair existing equipment scheduled to be reinstalled.

K. Protect and retain power to existing active equipment remaining.

L. Cap abandoned empty conduit at both ends.

M. Provide water-tight, knockout seals in panels, enclosures, gutters, or junction boxes where conduit has been removed.

N. Seal concrete penetrations, originally occupied by removed conduit, with suitable grouting material.

3.03 EXISTING PANELBOARDS

A. Trace out circuits in existing panelboards and document the as-built conditions, including what each circuit feeds, the size of the conductors for each circuit and the total volt-amp load on each circuit.

B. Remove all unused conductors due to scheduled demolition.

C. Provided as-built panel schedules at the completion of the Work.

3.04 SALVAGE ITEMS

A. Remove and protect items scheduled to be salvaged. Coordinate with OWNER where you are to locate these items

3.05 REUSABLE ELECTRICAL EQUIPMENT

A. Unless specifically identified for reuse, no used electrical equipment, conduit, conductors, components of any sort scheduled for demolition, disposal or salvage shall be installed for reuse on the project.

B. Electrical equipment identified specifically as being reused on the project shall be cleaned and protected until such time as it is reinstalled.

3.06 SCHEDULES

A. Salvage equipment identified by the OWNER at a location they identify. Coordinate the delivery of the salvaged items to the location identified by the OWNER at a time they have pre-approved.

B. Dispose of the following equipment and its associated components.

1. Existing electrical equipment, conduit, and conductors located at the storage buildings being demolished

2. Existing utility poles, meter bases, and any associated equipment identified on the Drawings.

C. Reuse the following items.

1. No items listed for reuse.

END OF SECTION

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SECTION 26 05 08

HAZARDOUS CLASSIFIED AREA CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Executing and completing Work in hazardous and/or classified areas as defined by the NEC Articles 500 through 516,

2. NFPA 820, and as indicated on the Drawings and specified in the Specifications.

B. Related Sections

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

1.02 REFERENCES

A. As specified in Section 26 05 00, Common Work Results for Electrical.

1.03 DEFINITIONS

A. As specified in Section 26 05 00, Common Work Results for Electrical.

B. Specific definitions:

1. For the purposes of these Specifications, the terms "Hazardous" and "Classified" will be considered synonymous.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01300, Submittal Procedures and Section 26 05 00, Common Work Results for Electrical.

1.06 QUALITY ASSURANCE

A. As specified in Section 26 05 00, Common Work Results for Electrical.

B. Regulatory requirements:

1. All wiring in hazardous and/or classified locations shall comply with all applicable articles of the NEC, in particular Articles 500 through 516.

2. Except as modified in Articles 500 through 516, all other applicable rules contained in the NEC shall apply to electric equipment and wiring installed in hazardous and/or classified locations.

3. All devices used in Class I Division 1 or Division 2 areas must have visible manufacturer installed nameplates specifically stating the Class, Division, and Group for which the device is approved.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 26 05 00, Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. A list of hazardous areas is specified in Section 26 05 00, Common Work Results for Electrical and indicated on the Drawings.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Conduit and sealing fittings:

1. As specified in Section 26 05 00, Common Work Results for Electrical.

B. Conduit boxes and bodies:

1. As specified in Section 26 05 33, Raceway and Boxes.

C. Wiring devices:

1. As specified in Section 26 27 26, Wiring Devices.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 26 05 00, Common Work Results for Electrical.

B. Conduit installation:

1. As specified in Section 26 05 33 - Raceway and Boxes.

2. Wrench tighten all conduit joints to minimize sparking when fault current flows through the conduit system.

3. Make all conduit connections so that there is a minimum of 5 threads fully engaged in the connection.

4. Flexible conduit:

a. Class I Division 1 hazardous areas:

1) Approved and marked suitable for Class I Division 1.

2) Listed for compatibility with the group type atmosphere where used.

b. Class I Division 2 areas:

1) Liquidtight metal conduit with approved fittings.

c. Maximum length as specified in Section 26 05 33 - Raceway and Boxes.

C. Sealing fittings:

1. Provide an approved seal, no more than 18 inches from the enclosure, for all conduits entering an enclosure containing switches, circuit breakers, fuses, relays, resistors, or any other apparatus which may produce arcs, sparks, or high temperatures:

    a. Only explosion proof unions, couplings, elbows, capped elbows, and conduit bodies like “L”, “T”, and “X” may be installed between the sealing fitting and the enclosure.

2. Provide entire assemblies approved for Class I locations for self- sealing or factory sealed assemblies where the equipment that may produce arcs, sparks, or high temperatures is located in a compartment separate from the compartment containing splices or taps, and an integral seal is provided where conductors pass from one compartment to the other:

    a. Seals are required in all conduit connections to the compartment containing splices and must be within 18 inches of the enclosure.

3. Install a conduit seal within 18 inches of the boundary in each conduit run entering or leaving a classified location. No union, coupling, box, or fitting is allowed in the conduit between the sealing fitting and the point at which the conduit leaves the classified location.

4. For underground conduits entering or leaving a classified location or between Class I Division 1 and Division 2 locations:

    a. Provide a conduit seal at both points where the conduit emerges from the ground:

        1) Place the conduit seal within 18 inches of finished grade.

        2) No union, coupling, box, or fitting is allowed in the conduit system between the seal fitting and the point at which the conduit enters the ground.

5. Separate all conductors within the conduit system and seal using an approved packing dam installed to both hold the sealing compound and to maintain the separation between the wires:

    a. Remove the outer jacket of multi-conductor non-shielded cables in the area of the sealing fitting and separate each conductor from the cable and seal individually.

6. Install seals with drains in all electrical control stations, low points of conduit or any place where moisture may condense and accumulate.

7. Install the sealing compound with a minimum thickness of 5/8 inch or the trade size of the conduit, whichever is greater.

8. All motors, actuators, and instrument transmitters required to have conduit seals shall have a union installed between the seal and the respective motor, actuator, or instrument transmitter. This will permit the motor, actuator, or transmitter to be disconnected or replaced without disturbing the wiring or conduit seal.

D. Boxes and fittings:

1. Class I Division 1 areas:

a. Utilize threaded connections for all metallic boxes, fittings, and joints to the conduit system.

2. Class I Division 2 areas:

a. Provide approved grounding bushings on conduits entering and exiting metallic boxes to bond the conduits together.

E. Outlet boxes and bodies:

1. Provide conduits bodies and boxes suitable for the conduit system as specified in Section 26 05 33 - Raceway and Boxes.

2. Class I Division 2 areas:

a. Boxes not containing arcing parts:

1) Material and NEMA ratings as specified in Section 26 05 00, Common Work Results for Electrical.

2) Pressed metal boxes are not allowed.

b. Provide heavy duty cast construction type conduit fittings and joints:

1) Explosion proof rated fittings and joints are not necessary.

c. Any enclosure containing arcing parts, etc. shall have all construction associated with the enclosure, conduit system, etc. conforming to Class I Division 1 construction.

F. Motor connections:

1. Conduit installation in Class I Division 1 and Class I Division 2 locations for motors that contain arcing parts, shall proceed as follows:

a. First - Conduit.

b. Second - Explosion proof flexible coupling.

c. Third - Sealing fitting.

d. Fourth - Explosion proof union.

e. Fifth - Connection to the motor terminal box.

2. Wiring connections to motor leads shall be as specified in Section 26 05 83, Low Voltage Wire Connections.

3. Bond the non-current-carrying metal parts of equipment, raceways and other enclosures as required by the NEC to ensure electrical continuity.

G. Grounding

1. A grounding conductor shall be provided in all raceways, junction boxes, and enclosures located within all Class 1 Division 1 and Class 1 Division 2 locations.

3.02 TESTING AND FACILITY STARTUP

A. As specified in Section 26 01 15, Demonstration And Training.

3.03 FIELD QUALITY CONTROL

A. As specified in Section 26 05 00, Common Work Results for Electrical.

B. Obtain inspection and approval from the Engineer before and after each seal is poured.

END OF SECTION

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SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. The section includes the requirements for conductors and cables used to conduct potentials of 600 volts and less.

2. All conductors and cables shall be installed in conduit or approved raceways regardless of which Division the conductors or cables are specified.

1.02 REFERENCES

A. The following is a list of Standards which may be referenced in the Section.

1. American Society for Testing and Materials (ASTM).

a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.

2. National Electrical Contractors Association, Inc. (NECA): National Electrical Installation Standards (NEIS).

3. National Electrical Manufacturers Association (NEMA).

a. WC 3, Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

b. WC 5, Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

c. WC 7, Cross Linked-Thermosetting Polyethylene Wire and Cable for the Transmission and Distribution of Electrical Energy.

d. WC 55, Instrumentation Cables and Thermocouple Wire.

4. National Fire Protection Association (NFPA). 70, National Electrical Code (NEC).

5. Underwriters Laboratories, Inc. (UL).

a. 13, Standard for Power-Limited Circuit Cables.

b. 44. Standard for Safety Rubber-Insulated Wires and Cables.

c. 62, Standard for Safety Flexible Cord and Fixture Wire.

d. 510, Standard for Safety Insulating Tape.

e. 854, Standard for Safety Service-Entrance Cables.

f. 910, Standard for Safety Test Method for Fire and Smoke Characteristics of Electrical and Optical Fiber Cables Used in Air Handling Spaces.

g. 1277, Standard for Safety Electrical Power and Control Tray Cables.

h. 1581, Standard for Safety References for Electrical Wires, Cables and Flexible Cords.

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 26000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Single Copper Conductors (THHN / THWN-2) (260519.C01).

1. Conductors shall be rated for 600 volts and conform to applicable requirements of NEMA.

2. Conductors shall be stranded copper.

3. Insulation type shall be THWN-2.

4. Conductors shall be sized per the Drawings and the NEC, whichever is greater.

5. Rome Cable Corporation, Southwire Company, Okonite Company, or approved equal.

B. Single Copper Conductors (XHHW / XHHW-2) (260519.C02).

1. Conductors shall be rated for 600 volts and conform to applicable requirements of NEMA.

2. Conductors shall be stranded copper.

3. Insulation type shall be XHHW / XHHW-2.

4. Conductors shall be sized per the Drawings and the NEC, whichever is greater.

5. Rome Cable Corporation, Southwire Company, Okonite Company, or approved equal.

C. Twisted Shielded Pair (TSP) Cables (260519.T01).

1. TSP cable shall be rated for 600 volts and conform to applicable requirements of NEMA.

2. Conductors shall be stranded copper. The gauge shall be 18 AWG unless specifically stated otherwise in the Drawings for a particular instance.

3. TSP cable shall be designed for noise rejection for process control, computer, or data log application in meeting NEMA WC55 requirements:

a. Outer Jacket: 45-mil nominal thickness.

b. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.

c. Dimension: 0.28-inch nominal OD.

d. Conductors:

1) Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.

2) 26 AWG, seven-strand tinned copper drain wire.

3) Insulation: 15-mil nominal PVC.

4) Jacket: 4-mil nominal nylon.

5) Color Code: Pair conductors black and white

4. Overall jacket type shall be PVC.

5. Conductors shall be twisted and bonded along their length to maintain uniform twists. The number of pairs shall be as identified in the Drawings with a drain wire and overall aluminum foil shield.

6. Belden, General Cable, AFC Cable Systems, or approved equal.

D. Twisted, Shielded Triad (TST) Cable (260519.T02).

1. Single triad shall be designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

2. Outer Jacket: 45-mil nominal.

3. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
4. Dimension: 0.29-inch nominal OD.
5. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
    b. 26 AWG, seven-strand, tinned copper drain wire.
6. Insulation: 15-mil nominal PVC.
7. Jacket: 4-mil nylon.
8. Color Code: Triad conductors black, red, and white.
9. Provide Southwire Triplex, or approved equal.

E. Shielded Category 6 (CAT 6) Cable (260519.N01)

1. Conductors:
    a. 24 AWG solid bare copper conductors.
    b. Shielded cable with shielded connectors.
    c. Provide strain relief on connectors.
    d. Rated for 600V.
2. Insulation:
    a. Polyolefin.
    b. 4 non-bonded twisted pair cables formed into a cable core.
3. Color Code:
    a. Pair 1: White/Blue Stripe and Blue
    b. Pair 2: White/Orange Stripe and Orange
    c. Pair 3: White/Green Stripe and Green
    d. Pair 4: White/Brown Stripe and Brown
4. Outer Jacket:
    a. Oil and sunlight resistant PVC with ripcord.
    b. Color red.
5. Electrical Characteristics:
    a. Frequency Range: 0.772-100 MHz.
    b. Attenuation: 32.1dB/100m.
    c. Near-End Crosstalk (NEXT): 39.3 dB.
    d. Power Sum NEXT: 37.3 dB.
    e. Attenuation to Crosstalk Ratio: 7.2 dB.
    f. Power Sum Attenuation to Crosstalk Ratio: 5.3 dB/100m.
    g. Equal Level Far-End Crosstalk (ELFEXT): 22.8 dB.
    h. Power-Sum ELFEXT: 19.8 dB/100m.

i. Return Loss: 17.3 dB.

j. Propagation Delay: 537 ns/100m.

k. Delay Skew: 45 ns/100m.

l. Propagation Delay (Skew), max: 2.5 ns/100m

6. Provide shielded CAT6 RJ45 jacks on each cable.

7. Provide Belden, or approved equal.

F. Fiber Optic Cable (260519.N02)

1. Multimode Fiber shall be 50/125 µm core diameter cable and meet the following requirements:

a. OM3 cable rated for 10Gb/s.

b. OFNP rated cable.

c. Rated for indoor/outdoor use.

d. Optical fibers shall be placed inside a tight buffer tube.

e. Core diameter: 50 ± 3.0 micrometers.

f. Cladding diameter: 125 ± 2.0 micrometers.

g. Core-to-cladding Offset: ≤ 3.0 micrometers.

h. Cladding non-circularity: ≤ 2.0%. Defined as: [1-(min. cladding dia. + max. cladding dia.)] X 100.

i. Core non-circularity: < 6.0%. Defined as: [1-(min. core dia. + max. core dia.)] X 100.

j. Coating Diameter: 245 + 10 micrometers.

k. Jacket color: Aqua

l. Graded index.

m. Numerical Aperture: 0.275 ± 0.015.

n. Attenuation Uniformity: There shall be no point discontinuities greater than 0.2 dB at either 850 nm or 1300 nm.

2. Fiber Optic Cable Connectors

a. All optical fibers shall be terminated with connectors that are type LC.

b. Provide LC connectors, one end with pre-terminated LC connectors and install LC connectors on other end after routed inside PLC panel.

2.02 ACCESSORIES

A. Colored Tape (260519.T01).

1. Colored tape shall be used to identify individual conductors larger than # 6 AWG.

2. 3M colored tape, or approved equal.

B. Cable Ties (260519.T05).

1. Cable ties shall be nylon, adjustable, self-locking, and properly sized for the bundle and force implied.

2. Thomas and Betts, Panduit, or approved equal.

C. Pulling Compound (260519.P01).

1. Pulling compound shall be non-corrosive, noncombustible, nonflammable waxed based lubricant listed for this use.

2. Ideal Company, Polywater, Inc., or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. All identification labeling shall be in compliance with Section 26 05 53 Identification for Electrical Systems.

2. Conductor and cable installations shall meet or exceed the NECA National Electrical Installation Standards.

3. CONTRACTOR shall not exceed the manufacturer's recommendations for maximum pulling tensions or minimum bending radii for respective conductors or cables.

4. Pulling compound is recommended for all conductor or cable installations and shall be used on all installations requiring a mechanical pulling device.

5. CONTRACTOR shall furnish and use a dynamometer on all conductor or cable installations requiring the use of a mechanical pulling device. The dynamometer shall be used to verify the maximum pulling tensions are not exceeded. Should the pulling tensions be exceeded, the conductor or cable shall be removed from the raceway and discarded. It shall not be reused under any circumstance on the project. The CONTRACTOR shall be responsible to make the alterations necessary before attempting to re-pull new conductors or cables.

6. Immediately after pulling in conductors or cables, the pulling compound shall be completely removed from the conductors or cables, from boxes, enclosures, floors, walls, etc.

7. Conductor and cable installations shall be continuous without splices or intermediate terminations unless specifically identified on the Drawings or prior written approval from the ENGINEER.

8. Where conductors or cables are routed in boxes enclosures or cable tray they shall be neatly bundled with cable ties at intervals not to exceed 12 inches on center. The tension for the cable ties shall be set with a tool specifically manufactured for that purpose and of the same manufacturer as the cable tie. Side cutters, linemen pliers and similar tools shall not be used to cut the tail end of the cable tie. The CONTRACTOR shall only use the tool specifically manufactured for this purpose and of the same manufacturer as the cable tie.

9. Conductors and cables shall not be installed until the raceway, boxes, enclosures, conduit bushings, etc. have all been installed. Where conductors or cables have been installed prior to meeting this requirement, the ENGINEER shall at their discretion elect to have the conductors or cables removed, disposed of and replaced with new product.

10. Should the outer jacket of any conductor or cable be damaged in any way, they shall be removed, disposed of and replaced with new product.

11. An equipment grounding conductor shall be installed in all raceways. Size shall be as identified on the Drawings or the NEC, whichever is greater, but in no case shall it be less than # 16 AWG for under 50 volts and no less than # 14 for 50 volts or above.

B. Category Cable Testing

1. The permanent link shall be tested.

2. All test results shall be used by the CONTRACTOR to determine any polarity and noise anomalies and CONTRACTOR shall take immediate corrective action for all anomalies.

3. Test results shall be used by the CONTRACTOR to determine the viability of each sheath for transmission in accordance with the specifications of the cable manufacturer and the requirements imposed by the transmission system. This shall form part of the acceptance procedure for the cable plant. All results obtained by use of pair-scanner testing shall be collated by terminal outlet number and or riser pair number and presented to the OWNER at the conclusion of the testing. Test compilation shall be initialed and dated by the CONTRACTOR's technician performing the test.

4. The CONTRACTOR shall utilize a level-III Fluke, PentaScanner, Wavetek or equal, twisted pair test instrument for the testing of all System Category copper cabling. All Category cable paths shall be tested at each jack for the following parameters and meet the requirements imposed by the TIA/EIA 568-B3 building wiring standard.

5. Category data cabling systems shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above and provide for the following tests.

   a. Wire Map.
   b. Cable Length.
   c. Pair-to-Pair NEXT.
   d. Power Sum NEXT.
   e. Attenuation.
   f. Pair-to-Pair ELFEXT.
   g. Power Sum ELFEXT.
   h. Return Loss.
   i. Propagation Delay.
   j. Delay Skew

6. A complete cable certification report shall be provided covering all locations.

7. The CONTRACTOR shall compile test results into the forms that contain all applicable test data. An external drive containing the test data and appropriate application (software) to display such in a windows-based environment shall be provided.

C. Fiber Optic Cable Third Party Testing

1. Perform testing after routing of 12-strand fiber optic cable and installation of all 24 LC connectors.
2. All of the cables/fibers shall be tested by an independent third party.
3. The Contractor shall obtain and pay for the services of a third party. The third party shall have a minimum of five (5) years of verifiable work experience performing fiber testing. A written list of references shall be made available to the District, if requested.
4. The third party shall test all fibers using an OTDR and provide traces with maximum fiber loss in compliance with standard TIA-568-C.
5. 3.5 dB/km @ 850nm
6. 1.5 dB/km @ 1300nm
7. All fiber which fails the testing shall be replaced by the Contractor at no additional cost to the District.
8. All test results shall be provided to the District in electronic (PDF) and hard copy (printed) format.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. The section includes requirements for grounding electrodes, equipment grounding and electrical bonding.

1.02 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 013300 – Submittal Procedures.

2. Manufacturer’s data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Ground Rods (260526.G01).

1. Ground rods shall be provided as shown on the drawings.
2. Ground rods shall be copper clad.
3. Ground rods shall be a minimum of 5/8 inch diameter.
4. Ground rods shall be a minimum of 10 feet long.

B. Compression Connectors (260526.C20).

1. Compression connections shall be provided as shown on the drawings and as required for bonding end-use equipment.
2. Compression connections shall be compress-deforming type, extruded copper material.
3. Compression connections shall be tin electroplated for corrosion resistance.
4. Compression connections shall be ring-type connectors. Forked connectors shall not be used on grounding conductors.
5. Provide Burndy products, or approved equal.

C. Mechanical Connectors (260526.C21).

1. Mechanical connectors shall be provided as shown on the drawings and as required for bonding to pipes.
2. Mechanical connectors shall be UL 467 Listed, copper material.
3. Mechanical connectors shall be sized to match the pipe being bonded.
4. Mechanical connector clamps shall permit parallel or 90° cable connection.
5. Mechanical connectors installed below-grade shall include silicon bronze hardware.
6. Provide Burndy GAR3902 series for above-ground installations, or approved equal.
7. Provide Burndy GAR-BU series for below-grade installations, or approved equal.

D. Ground Test Well (260526.G60).

1. Ground test wells shall be provided as shown on the drawings.
2. Provide Utility Vault box type # 3VB-1012B, or approved equal.
3. Provide Utility Vault traffic cover # 1/3 VCB-C1 cover with custom “GROUND” marking on cover, or approved equal.

E. Ground Bars (260526.B01).

1. Ground bars shall be provided as shown on the drawings.
2. Provide Cutler-Hammer model GBK21, GE model TGK42, Square D model PK27GTA, or approved equal.

F. Ground Bushings (260526.B10).

1. Split bushing shall be insulated, zinc die cast steel.

2. Bushing shall be sized by the Contractor for grounding conductor served.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. All identification labeling shall be in compliance with Section 26 05 53 Identification for Electrical Systems.

2. Bond separately derived systems, including generators, to the grounding electrode system.

3. Maintain equipment ground continuity throughout the facility by means of a grounding conductor routed in all raceways.

4. Provide grounding conductors pursuant to Section 26 05 19. Conductors shall be copper and shall be sized per the Drawings or the NEC, whichever is greater.

5. Provide ground bushings for all conduits that do not terminate in a hub type fitting and install at the source of power with a bonding conductor fastened to the ground bushing.

6. Provide ground bar kits as shown on the Drawings and where two (2) or more grounding conductors are terminated in a box or enclosure.

7. Install ground rods at the locations and in the number shown on the Drawings or per the NEC, whichever is greater.

8. Bond the grounding electrode system to all metallic water and wastewater piping.

B. Ground Bushings.

1. Provide a grounding type bushing with lug for connection of grounding conductor for conduits that originate from each motor control center section, switchboard, or panelboard:

a. Individually bond these raceways to the ground bus in the equipment.

2. Provide grounding type bushings with lug for a connection to a grounding conductor for all conduits which terminate at a cable tray.

3. Provide grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.

4. Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

C. Grounding Conductors.

1. Brush grounding conductors clean of debris before connections are made.

2. Strip insulated conductor insulation in a neat, workman like manner where insulated conductors are used.

3. Fasten all conductors securely.

D. Connections.

1. Install connectors according to the manufacturer's directions, using the proper dies, tools, molds, shots, loads, etc. designed specifically for this purpose.

2. Provide irreversible welded type connections to ground rods, re-bar, lightning protection box, building steel etc.

3. Provide compression connector type connections to end use equipment and bolt to the equipment using washers and split lock washers for secure fastening. Bolts shall be grade 5 for grounding connections and shall be tightened to the manufacturer's recommend torque.

E. Ground Test Wells.

1. Install ground test wells at locations shown on the Drawings.

2. Install ground test wells such that the cover is flush with finished grade.

3. Install the ground rod within the well six (6) inches below grade.

4. Provide a minimum of six (6) inches of well compacted, ¾ minus gravel installed beneath the ground well box.

5. Place backfill within the ground test well to allow room for test equipment to be connected to the ground rod.

END OF SECTION

SECTION 26 05 28

SEISMIC RESTRAINTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Requirements pertaining to seismic restraints for electrical equipment.

1.02 REFERENCED STANDARDS

A. The following is a list of standards which may be referenced in this Section:

1. 2019 Oregon Structural Specialty Code.

2. 2018 International Building Code.

3. American Society of Civil Engineers (ASCE)

a. ASCE 7-16 Minimum Design Loads and Associated Criteria for Buildings and Other Structures

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data.

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, equipment weight and related information for each item specified in PART 2 PRODUCTS.

3. Seismic calculations and drawings.

1.04 REQUIREMENTS

A. This project shall comply with the current edition of the Oregon Structural Specialty Code, Oregon Electrical Specialty Code, and ASCE 7-16.

B. The seismic restraints for the project shall be designed to the following design criteria:

1. Reference the seismic design specs in 01 61 10 Seismic Design, 01 61 11 Seismic Anchoring and Bracing, and 01 61 50 Wind Design Criteria.

C. The following electrical systems shall be provided with engineered seismic restraints:

1. Generators and automatic transfer switches

2. Cable tray and cable runway systems.

3. Suspended and supported conduit systems.

4. Switchgear and switchboards.

5. Transformers, wall mounted.

6. Transformers, floor mounted.

7. All electrical enclosures weighing more than 20 lbs. This shall include, but not be limited to, panelboards, control panels, general enclosures, and luminaires.

8. All other Electrical Systems required by ASCE 7-16 and the Oregon Structural Specialty Code.

D. The CONTRACTOR shall pay for and obtain the services of a licensed Structural or Civil LICENSED ENGINEER in the State of Oregon. The LICENSED ENGINEER shall provide the following:

1. Restraint, bracing, and anchorage calculations and details. These details shall be project specific. Typical bracing details for commonly used restraint systems shall be acceptable.

a. The details and calculations shall be suitable for a deferred submittal to the AHJ for the purposes of obtaining an electrical permit.

b. Number, size, capacity, and location of seismic restraints.

c. Backing material to be used in stud wall applications.

d. The details and calculations shall be suitable for installation by the CONTRACTOR.

2. The LICENSED ENGINEER shall provide shop drawings for review and approval by the ENGINEER OF RECORD. The shop drawings shall include:

a. Project-specific restraint details.

b. Project-specific calculations

c. Wet stamped/signed documents.

3. The LICENSED ENGINEER shall perform an on-site inspection of the seismic restraint installation performed by the CONTRACTOR. The LICENSED ENGINEER shall provide a written report of the inspection, including identifying any deficiencies. The report shall be submitted to the ENGINEER OF RECORD for review and approval. The inspection shall be performed by the LICENSED ENGINEER prior to the bracing being covered. The CONTRACTOR shall bear the responsibility of scheduling this inspection.

   a. The CONTRACTOR shall be responsible for installing all seismic restraints per the LICENSED ENGINEER's requirements. Make all corrections required by the LICENSED ENGINEER.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Seismic Restraints (260548.R01).

1. Restraints shall be provided as directed by the SPECIALTY ENGINEER.

2. Material type shall confirm with the requirements of 26 05 29 Hangers & Supports for Electrical Systems.

3. Bracing shall utilize strut channel style systems. The use of cable type systems shall not be permitted.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. Install all restraints as directed by the SPECIALTY ENGINEER and as required by Code.

END OF SECTION

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements pertaining to electrical equipment anchoring and electrical equipment hanging and support.

1.02 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 26000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

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4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data.

1. Pursuant to Section 01 33 00 Submittals.

2. Manufacturer's data including materials of construction, equipment weight and related information for each item specified in PART 2 PRODUCTS.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless Steel Hardware (260529.H01).

1. Bolts shall be 316 or 304 stainless steel and sized for the load served and have a hex head unless specifically specified otherwise elsewhere.

2. Nuts shall be 316 or 304 stainless steel hex nut.

3. Washers shall be 316 or 304 stainless steel, USS pattern flat washers.

4. Split lock washers shall be 316 or 304 stainless steel.

5. Threaded rods and couplings shall be 316 or 304 stainless steel.

6. Eye-bolts, u-bolts, bent-bolts and similar connecting hardware shall be 316 or 304 stainless steel.

B. Galvanized Hardware (260529.H11).

1. Bolts shall be hot dipped galvanized steel and sized for the load served and have a hex head unless specifically specified otherwise elsewhere.

2. Nuts shall be hot dipped galvanized steel hex nut.

3. Washers shall be hot dipped galvanized steel, USS pattern flat washers.

4. Split lock washers shall be hot dipped galvanized steel.

5. Threaded rods and couplings shall be hot dipped galvanized steel.

6. Eye-bolts, u-bolts, bent-bolts and similar connecting hardware shall be hot dipped galvanized steel.

C. Stainless Steel Anchors (260529.A01).

1. Wedge or stud anchors installed in concrete or masonry shall be 316 or 304 stainless steel and sized for the load served.

2. Toggle type fasteners shall only be used in hollow sheetrock wall. The wing part of the fastener may be mild steel, but the bolt shall be stainless steel.

D. Galvanized Anchors (260529.A11).

1. Wedge or stud anchors installed in concrete or masonry shall be hot dipped galvanized steel and sized for the load served.

2. Toggle type fasteners shall only be used in hollow sheetrock wall. The wing part of the fastener may be mild steel, but the bolt shall be hot dipped galvanized steel.

E. Stainless Steel Beam Clamps (260529.B01).

1. Beam clamps shall be 316 or 304 stainless steel and sized for the load served.

F. Galvanized Beam Clamps (260529.B11).

1. Beam clamps shall be hot dipped galvanized steel and sized for the load served.

G. Galvanized Strut Channel (260529.S01).

1. Galvanized strut channel shall be hot dipped galvanized after fabrication and shall be a minimum of 12 gauge.

2. Galvanized strut channel shall have factory pre-drilled holes.

H. Stainless Steel Strut Channel (260529.S16).

1. Stainless steel strut channel shall be 316 or 304 stainless steel and shall be a minimum of 12 gauge.

2. Stainless steel strut channel shall have factory pre-drilled holes.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. Refer to Section 26 05 00, Part 1.13, Paragraph B, Plant Area Work Requirements for specific requirements regarding permitted hardware type use.

2. Hardware shall be set to a torque as recommended by the manufacturer.

3. Washers and split lock washers shall be installed on all bolts, threaded rods and anchors.

4. Lead or plastic type anchors are prohibited from use on the project.

5. When threaded rods are installed in drop-in type anchors, a washer, split lock washer and a jamb nut shall be installed at the anchor to ensure stability.

6. When channel (strut) is installed as a hanger or support from threaded rod, washers, split lock washers and jamb nuts shall be installed on both sides of the strut to lock it in place.

7. Cut ends of channel, strut, threaded rods or other cut fittings shall be filed smooth before installation.

8. Cut ends of hot dipped galvanized channel and strut shall be coated with three coats of cold galvanizing compound after the channel has been filed to prohibit rust.

9. Galvanized channel and strut shall only be installed indoors in non-corrosive areas. Stainless steel channel and strut shall be installed everywhere else including outdoors and in corrosive areas.

10. Concrete anchors shall be installed as per the manufacturer's directions and set using the manufacturer's supplied tool.

11. Threaded rod shall not extend more than one (1) inch beyond the channel, strut or other material it is supporting.

12. Hangers and supports shall be installed level and plumb.

13. Provide strut plastic end caps at the ends of all struts that are exposed to unintentional contact by personnel. Plastic end caps shall be safety yellow finish or color as directed by the OWNER.

14. Hangers and supports shall be installed per the National Electrical Code, Building Code and Structural Code and shall be designed to safely support the load. The ENGINEER may request the CONTRACTOR provide a copy of their design calculations for the seismic requirements and the load served.

B. Dissimilar Metals

1. Provide corrosion protection tape around conduits that are dissimilar material than the hardware material, such as rigid aluminum conduit and stainless steel hardware. Conduits and hardware that are dissimilar metals shall not be installed in direct contact of each other. Tape shall be 20 mil thick. Wrap shall be 50% overlap minimum. The wrap shall extend 1/4" minimum beyond the edge of the strap, strut, or fitting.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. The Section includes the requirements pertaining to conduits and fittings used to contain electrical conductors and cables.

2. All conductors and cables shall be installed in conduit or approved raceways regardless of which Division the conductors or cables are specified.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this Section.

1. American National Standards Institute (ANSI).

a. C80.1, Rigid Steel Conduit-Zinc Coated.

2. American Society for Testing Materials (ASTM).

a. A123 E1, Standard Specification for Zinc-Coated (Galvanized) Coatings on Iron and Steel Products.

3. National Electrical Contractors Association (NECA).

a. National Electrical Installation Standards (NEIS).

4. National Electrical Manufacturers Association (NEMA).

a. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Coated and Intermediate Metal Conduit.

b. TC 3, PVC Fittings for use with Rigid PVC Conduit and Tubing.

c. TC 6, PVC and ABS plastic Utilities Duct for Underground Installation.

5. Nation Fire Protection Association (NFPA).

a. 70, National Electrical Code (NEC).

6. Underwriters Laboratories, Inc. (UL).

a. 6, Standard for Safety Rigid Metal Conduit.

b. 50 Enclosures for Electrical Equipment.

c. 514B, Standards for Safety Fittings for Conduit and Outlet Boxes.

d. 514C Standard for Safety Non-Metallic Outlet Boxes, Flush Device Boxes and Covers.

e. 651, Standard for Safety Schedule 40 and 80 PVC Conduit.

f. 651A, Standard for Safety Type EB and Rigid PVC Conduit and HDPE Conduit.

g. 1660, Standard for Safety Liquid-Tight Flexible Nonmetallic Conduit.

h. 360, Standard for Safety Liquid-Tight Flexible Metallic Conduit.

i. 797, Standard for Safety Electrical Metallic Conduit.

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 26000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

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4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.04 QUALITY ASSURANCE

A. PVC Coated Galvanized Rigid Steel Conduit Installation Training and Certification.

1. All installers of PVC Coated Galvanized Rigid Steel Conduit shall be factory trained and certified prior to the installation of any PVC Coated Galvanized Rigid Steel Conduit. CONTRACTOR shall provide written proof of current factory certification for all installers.

B. All PVC Coated Galvanized Rigid Steel Conduit shall be warranted for three (3) years, minimum.

1.05 CONDUIT MATERIAL TYPE

A. The CONTRACTOR shall be permitted to select between the following metallic conduit types on this project: PVC-RAC and RAC or PVC-GRC and GRC, where these types of conduits are required. All conduit run shall utilize steel or aluminum material only, and mixing of conduit types shall not be permitted. Refer to Section 260500 Part 1.12 (B) Plant Area Work Requirements for additional information.

PART 2 - PRODUCTS

2.01 CONDUIT

A. Galvanized Rigid Steel Conduit (GRC) (260533.C01).

1. Shall be mild steel, hot dipped galvanized inside and out.
2. Shall be manufactured in accordance with ANSI C80.1 – Rigid Steel Conduit, Zinc Coated, and UL-6.
3. Conduit fittings shall be hot dipped galvanized malleable iron.
4. Condulets shall form 7 type.
5. The use of three-piece couplings shall be incorporated only when unavoidable and not simply due to poor planning and layout.
6. The use of compression, setscrew and split conduit fittings is unacceptable.
7. Gaskets shall be installed on all condulet covers regardless of the environment they are installed in.
8. Conduit straps shall be hot dipped galvanized malleable iron and incorporate matching conduit spacers when attached directly to walls, ceilings and floors.
9. LTV steel, Triangle PWC, or approved equal.

B. Rigid Aluminum Conduit (RAC) (260533.C50).

1. Rigid aluminum conduit shall be manufactured of 6063-T1 alloy.
2. Manufactured in accordance with:
   a. ANSI C80.5
   b. UL 6A
3. Use of this conduit type is restricted to only locations permitted in Section 26 05 00. Refer to the Plant Area Work Requirements table which specifies the permitted uses for these conduit types.

C. PVC Coated Galvanized Rigid Steel Conduit (PVC-GRC) (260533.C10).

1. Shall meet the manufacturing specification of GRC before PVC coating is applied.
2. Shall be manufactured in accordance with NEMA RN1 Standard for PVC coated GRC.
3. Exterior PVC coating shall not be less than 40 mils thick.
4. The exterior coating shall be sufficiently flexible to permit field bending the conduit without cracking or flaking the coating.

5. Chemically cured two-part urethane coating, at a nominal 2 mil thickness shall be applied to the interior of all conduit and fittings.

6. Female conduit or fitting opening shall have a PVC sleeve extending one-conduit diameter or 2 inches; whichever is less, beyond the opening.

7. The inside diameter of the sleeve shall be the same diameter as the outside diameter of the conduit before the coating is applied.

8. The wall thickness of the sleeve shall be 40 mil minimum.

9. Conduit fittings, condulets, mounting hardware and accessories shall be PVC coated to the same specifications as the conduit.

10. Condulets shall be form 7 type.

11. Gaskets shall be installed on all condulet covers regardless of the environment they are installed in.

12. The screw heads on condulets shall be encapsulated by the manufacturer with a corrosion resistant material, or shall be stainless steel. All condulets shall have the same type of type of screw heads, stainless steel or encapsulated.

13. The use of three-piece couplings shall be incorporated only when unavoidable and not simply due to poor planning and layout.

14. The use of compression, setscrew and split conduit fittings is unacceptable.

15. Ocal Inc., Perma-coat, or approved equal.

D. EMT Conduit (260533.C70).

1. Hot galvanized steel with corrosion resistance inner diameter coating.

2. Manufactured in accordance with:

   a. ANSI C80.3

   b. UL 797

3. Fittings shall be watertight compression fittings, regardless of whether used indoors or outdoors. Set screw fittings shall not be acceptable.

4. Conduit connectors shall have insulated throats, plastic bushings or ground bushing installed.

E. Liquid-Tight Flexible Aluminum Conduit (LFAC) (260533.C20).

1. Shall be constructed of a flexible aluminum core with a sunlight resistant thermoplastic outer jacket.

2. Conduit fittings shall be manufactured to the PVC-GRC fitting specifications. Galvanized or non-metallic conduit fittings are unacceptable unless written approval is obtained from the ENGINEER for specific locations before installation.

3. No couplings shall be installed.

4. Sealing rings shall be installed where conduit terminates at an enclosure.

5. Conduit shall be Anaconda, Electriflex, T & B, or approved equal.

6. Sealing ring shall be OZ Gedney 4Q-G, or approved equal.

F. Rigid Non-metallic Conduit (PVC 40) (260533.C30).

1. Shall be schedule 40 PVC unless specifically called out otherwise on the Drawings.
2. Shall be sunlight resistant.
3. Shall be manufactured in accordance with UL-651 Standard.
4. Conduit and fittings shall be securely glued.
5. Provide conduit bell ends at vaults unless specifically called out otherwise on the Drawings.
6. Provide PW Pipe, Carlon, or approved equal.

G. Hazardous Location Flexible Coupling (260533.C40).

1. Shall be listed for Class 1, Division Hazardous Locations.
2. Shall be constructed of flexible brass tubing, insulating wire duct, bronze outer braid, bronze end fittings, and protective PVC coating.
3. Shall be liquid-tight.
4. Shall be Crouse Hinds EC Series, or approved equal.

2.02 CONDUIT ACCESSORIES

A. Conduit Thread Lubricant (260533.L01).

1. Shall be an electrically conductive with copper particles suspended in the product.
2. Provide Kopr-Shield Catalog number CP8-TB, or approved equal.

B. Glue (260533.G01).

1. Glue shall be the wet/dry rated cement commonly referred to as “Blue Glue”.

C. Conduit Duct Spacers (260533.S01).

1. Shall be used in conduit duct banks to maintain uniform spacing of conduits.
2. Shall be non-metallic, interlocking type manufactured for this purpose. Shall be sized to maintain a minimum of 3 inches of separation between conduits.
3. Provide Underground Devices Wunpeece, IPEX Monoblock, or approved equal.

D. Cord Grip (CGB) (260533.C89).

1. Provide stainless steel bodied cord grips with NPT mounted in conduit couplings as identified on the Drawings.
2. Provide Hubbell, Kellems, or approved equal.

E. Pulling Twine (260533.T31).

1. Provide 200 pound tensile strength pulling twine in spare conduits and as called out elsewhere on the Drawings.
2. Greenlee twine, or approved equal.

F. Cord Connector (260533.C90).

1. Provide stainless steel cord grip with integrated stainless steel mesh.
2. Provide Hubbell SCH1000 Series, or approved equal.
3. Provide cord grip with stainless steel integrated mesh for any unsupported cord longer than 59 inches to provide adequate support of the cord.

G. Bushing Plug (260533.P90).

1. Provide OZ Gedney type PPC bushing plug, or approved equal.

H. Conduit System Drain (260533.D33).

1. Provide a conduit system drain designed specifically for the purpose of draining accumulated condensate and to provide ventilation designed to minimize condensation.
2. The device shall UL Standard 514B certified.
3. The bodies and locknut shall be copper-free aluminum construction. The device shall be supplied with a stainless steel screen which may be removed and cleaned as required.
4. Provide a Cooper Crouse-Hinds 0.75 inch drain catalog number CD2-SA, or approved equal.

I. Threaded Hubs (260533.H01).

1. Hubs for threaded attachment of steel conduit to sheet metal enclosures:
2. Construction:
    a. Insulated throat.
    b. PVC coated when used in corrosive areas.
    c. Bonding locknut.
    d. Recessed neoprene O-ring to assure watertight and dust- tight connector.
    e. One half (1/2)-inch through 6-inch steel zinc electroplated.
    f. Aluminum with aluminum conduit.
3. Usage:
    a. All conduits shall use threaded hubs for connections to metal enclosures.
4. Provide Crouse-Hinds Myers Hub, or approved equal.

J. Iron Alloy Galvanized Seismic Deflection Coupling (260533.C91).

1. Use to compensate for movement in any directions between 2 conduit ends that they connect.
2. Shall allow movement of 3/4 inch from the normal in all directions.
3. Shall allow angular movement for a deflection of 30 degrees from normal in any direction.
4. Constructed to maintain electrical continuity of the conduit system.

5. Materials:

   a. End couplings: Bronze or galvanized ductile iron.

   b. Sleeve: Neoprene.

   c. Bands: Stainless steel.

   d. Bonding jumper: Tinned copper braid.

6. Provide Crouse-Hinds XD Series, or approved equal.

K. PVC Seismic Deflection Coupling (260533.S99).

1. Shall permit axial expansion or contraction up to 3/4".

2. Shall permit angular misalignment of the axes of the coupled conduit runs in any direction up to 30-degrees.

3. Shall permit parallel misalignment of the coupled conduit runs in any direction up to 3/4".

4. Watertight flexible neoprene outer jacket that is corrosion resistant. Jacket clamps shall be stainless steel.

5. Non-metallic PVC construction. Suitable for use with PVC 40 and PVC 80 conduit.

6. Thomas & Betts Non-Metallic Expansion/Deflection Coupling, or approved equal.

L. Sealing Fittings (260533.S02).

1. Construction:

   a. 40 percent wire fill capacity.

   b. Shall be rated for horizontal and vertical installations.

   c. PVC-coated when used in corrosive areas.

   d. Malleable ductile iron with steel conduit.

   e. Aluminum with aluminum conduit.

   f. Crouse-Hinds Type EYD where drains are required.

   g. Crouse-Hinds Type EYS where drains are not required.

   h. UL listed for use in Class I, Division 1, Groups A, B, C, D; Class I, Division 2, Groups A, B, C, D; Class II, Divisions 1 and 2; Groups E, F, and G.

2. Sealing compound:

   a. Fiber filler and cement as recommended by the sealing fitting manufacturer.

   b. Approved for the conditions and use.

      1) Not affected by surrounding atmosphere or liquids.

3. Melting point shall be 200 degrees Fahrenheit minimum.

4. Provide Crouse-Hinds, or approved equal.

M. Duct Seal (260533.D44).

1. Seal all conduits passing from the interior to the exterior of a building or structure with flexible/removable duct seal.

2. Provide Hubbell-Raco DS-XLB Duct Seal Weather Sealing, or approved equal.

2.03 DEVICE BOXES

A. Cast Iron Boxes (260533.B01).

1. Shall be cast iron galvanized boxes, have tapered threaded hubs and be the deep FD type in all cases.
2. Boxes shall have internal grounding screw.
3. Shall have external mounting tabs.
4. Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.
5. Provide OZ Gedney, Crouse-Hinds, or approved equal.

B. PVC Coated Cast Iron Boxes (260533.B10).

1. Shall comply with the specification for cast iron boxes.
2. Shall be coated to the same specifications as the PVC-GRC conduit.
3. Shall have external mounting tabs.
4. Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.
5. Provide Ocal, Perma-Coat, or approved equal.

C. Galvanized Sheet Metal Boxes (260533.B15).

1. Shall comply with NEMA specifications for sheet metal boxes.
2. Shall not exceed 4-11/16 inches square.

D. General Enclosures (NEMA 1) (260533.E01).

1. Shall be NEMA 1, painted steel.
2. Shall have an aluminum interior mounting panel (backpanel).
3. Shall be constructed of stainless steel with hinged and gasketed door.
4. Provide with necessary accessories and those shown on the Drawings.
5. Provide a grounding kit.
6. Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.

E. General Enclosures (NEMA 4X) (260533.E40).

1. Shall be NEMA 4X, 316 stainless steel.
2. Shall have an aluminum interior mounting panel (backpanel).
3. Shall be constructed of stainless steel with hinged and gasketed door.
4. Provide with necessary accessories and those shown on the Drawings.
5. Provide a grounding kit.

6. Whichever manufacturer is submitted and approved, all like boxes on Project shall be of the same manufacturer.

F. Large In-Ground H15 Concrete Polymer Box (260533.M21).

1. Shall be polymer concrete in ground box with flush polymer cover.
2. Lid Dimensions shall be 24” x 36” x 18” deep.
3. Lid shall be rated for Tier 15 loading.
4. Bolts shall be provided with tamper resistant bolts for cover.
5. Cover shall have verbiage molded into the top identifying the type of service served such as electric, fiber optic, communications, etc.
6. Provide Old Castle FRP, or approved equal.

G. Large In-Ground Pedestrian HDPE Box (260533.M02)

1. Shall be HDPE in ground box with flush HDPE cover.
2. Lid Dimensions shall be 24” x 24”.
3. Base shall be 36” x 36” x 18” deep.
4. Lid shall be ASTM Pedestrian rated.
5. Bolts shall be provided with penta-head bolts for cover.
6. Cover shall have verbiage molded into the top identifying the type of service served such as electric, fiber optic, communications, etc.
7. Shall be Old Castle Carson 24 Series, or approved equal.

H. Large In-Ground H20 Concrete Box (260533.M31).

1. Provide concrete in ground box with flush H20 steel checkered lid.
2. Lid Dimensions shall be 30” x 17” x 12” deep.
3. Lid shall be rated for Tier 20 loading.
4. Bolts shall be provided with tamper resistant bolts for cover.
5. Cover shall have verbiage molded into the top identifying the type of service served such as electric, fiber optic, communications, etc.
6. Provide Old Castle Christy B1730, or approved equal.

I. Large Manhole (260533.M41).

1. Concrete construction.
2. Shall be 50” x 50” (interior), 56” x 56” (exterior).
3. Height shall be 66” (interior), 72” exterior.
4. Cover all be square with square galvanized steel diamond plate door with locking latch. Door shall open 180-degrees.
5. Old Castle 506-LA or approved equal.

J. Cable Support Arms (260533.A04).

1. Provide non-metallic cable support arms in the power and control vaults.

2. Arms shall be installed such that there is no more than 30 inches between each support arm or duct bank conduit entry.

3. Provide enough cable supports arms to neatly lie in the cables and 25 % spare unused space.

4. Provide Underground Devices, Inc. cable rack and support arms, or approved equal.

K. Vault and In-Ground box Identification Nameplates (260533.N10).

1. Provide stainless steel nameplates, minimum 1/16 inch thick, 1.5 inches high and 3.0 inches long with Black etched characters 1.0 inch high in Times New Roman font.

2. Attach the nameplates, centered on the top of the boxes or vaults with stainless steel rivets with the smooth side exposed.

3. The nameplates shall match the verbiage on the Drawings. If no verbiage exists, the CONTRACTOR shall meet with the ENGINEER to determine the appropriate verbiage and shall note the verbiage on the as-built Drawings.

PART 3 - EXECUTION

3.01 CONDUIT INSTALLATION

A. General Requirements

1. Refer to Section 26 05 00, Part 1.13, Paragraph B, Plant Area Work Requirements for specific requirements regarding permitted hardware type use.

2. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems

3. Install conduit runs in accordance with the schematic representation shown on the Drawings.

4. Refer to the Plant Area Work Requirements Table in section 26 05 00 which specifies the permitted uses for conduit types.

5. Metallic conduit runs shall be of the same material type only. Mixing of material types, such as steel and aluminum in the same conduit run shall not be permitted.

   a. PVC-GRC elbows installed in floor slabs shall be permitted to transition to RAC conduit. Provide conduit lubricant thread with anti-corrosion properties on all RAC and PVC-GRC surfaces which make contact.

6. RAC that passes through concrete walls shall be protected against corrosion using bitumastic tape wrap paint or other approved product. Install bitumastic paint per manufacturer's instructions.

7. RAC shall not be installed directly in contact with concrete. Utilize strut channel to maintain separation between the conduit and concrete.

8. RAC shall not be installed in concrete or direct buried.

9. Minimum conduit size shall be 0.75 INCH unless specifically called out otherwise on the drawings.

10. Where raceways are indicated, but the routing is not identified, the routing shall be the CONTRACTOR'S choice and in accordance with the rest of the Contract Documents and the National Electrical Code (NEC).

    a. Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.

    b. Modify conduit runs to suit field conditions, as accepted by the Engineer:

        1) Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.

        2) Make changes in conduit routing due to the relocation of equipment.

    c. The Electrical Drawings do not indicate all required junction boxes and pull boxes:

        1) Provide junction boxes and pull boxes to facilitate wire pulling as required to meet the manufacturer's pulling tension requirements and to limit the total number of bends between pull locations..

        2) Install junction boxes and pull boxes at locations acceptable to the Engineer.

    d. The Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the circuit/raceway block diagrams without the express written approval or direction by the Engineer:

        1) The Engineer is the sole source in determining whether the change is constituted as a deviation:

        2) Perform any changes resulting in additional conduits, or extra work from such deviations.

        3) Incorporate any deviations on the Record Documents.

    e. Owner reserves the right to deduct the amount of applicable reimbursement, equivalent to the cost of the engineering effort required to show those unauthorized changes on Record Drawings.

11. Raceways shall be electrically and mechanically complete before the conductors are installed.

12. Routing of conduits may be adjusted to avoid obstructions. Coordinate with other trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation and removal and reinstallation to resolve conflicts shall be at the CONTRACTOR's expense.

13. Conduit joints shall be wrench tight, thoroughly grounded, secure and free of obstructions.

14. Conduits shall be reamed.

15. Metallic threads shall all be coated with conduit thread lubricant before assembly. Failure to install the lubricant will result in removal of all conduit and reassembly with the conduit lubricant.

16. Exposed conduits shall be installed parallel or perpendicular to the structural members and surfaces and shall be level and or plumb.

17. When two or more conduits are routed in the same general direction their routing shall be parallel with symmetrical bends.

18. Conduits shall be bent with equipment specifically designed for this purpose and for the specific size and type of conduit.

19. Conduits that are creased or crushed shall be replaced.

20. Install conduits such that they do not interfere with the proper and safe operation of equipment and do not block or otherwise interfere with the ingress and egress and installation of removable hatches and covers.

21. Install expansion joints as needed across expansion joints in the structure and at other locations where necessary to compensate for thermal or mechanical expansion or contraction.

22. Conduits shall be routed at least six (6) inches from high temperature piping, ducts and flues.

23. Conduits that terminate at an enclosure that does not have a threaded hub shall be installed with a Myers type hub and ground ring. No exceptions shall be permitted without prior written approval for specific locations issued by the ENGINEER. Conduits that are permitted to terminate without a Myers type hub or a threaded hub shall have a ground bushing installed. A separate bonding conductor shall be routed to all ground bushings within an enclosure and be bonded to the enclosure and grounding conductor if present.

24. Final connections to dry type transformers, motors, instruments and other equipment requiring a flexible connection shall be made with LFAC conduit. Lengths shall not exceed three (3) feet.

25. All conduits shall be capped throughout construction to prevent entrance of dirt, trash, water, etc.

26. All conduits that are trade size 2.5” and larger which are routed through floors, ceilings or walls below grade shall include a large enough opening to accommodate the installation of Link-Seal. After installation and inspection of the Link-Seal, the CONTRACTOR shall install non-shrink type grout that matches the color of the surrounding material. The grout shall be installed on both sides of the Link-Seal installation.

27. Support conduit runs on water-bearing walls a minimum of 7/8- inch away from wall on an accepted preformed channel:

    a. Do not run conduit within water-bearing walls unless otherwise indicated on the Drawings.

28. When installing conduit through existing slabs or walls make provisions for locating any possible conflicting items where conduit is to penetrate. Use tone

signal or X-ray methods to make certain that no penetrations will be made into existing conduit, piping, cables, post-tensioning cables, etc.

29. All power conduits routed to or from an adjustable frequency drive or a variable frequency drive shall be metallic conduit. Conduits installed underground shall meet the requirements listed below under part B; underground and concrete encased conduit installation.

30. Spare conduits shall be provided with a coupling and threaded male plug that matches the makeup of the conduit for the area they are installed in. The conduit shall terminate at an enclosure when one is called out and exists as part of the Work. Where the spare conduit is stubbed up in a concrete slab for future equipment, it shall be installed flush with the finished floor. Where spare conduits are routed to other areas such as outside a building envelope, in an attic, to a vault, etc., the conduit shall have a female conduit cap installed.

31. All conduits shall be individually identified at every point they terminate. The conduit identification shall be the same as that which is used on the conduit /conductor schedule in the Drawings. Should conduits be installed that are not listed on the conduit schedules, the CONTRACTOR shall add conduit callouts to the as-built conduit schedules and label the conduits accordingly.

32. For innerduct installations, provide liquid tight connectors where appropriate. No splicing of the innerduct is allowed.

B. PVC-GRC Conduit Installation

1. Strap wrenches and vises shall be used to install PVC-GRC conduit to prevent wrench marks and damage to the outer PVC coating. Conduits with damaged coating shall be replaced, repair is unacceptable.

2. Conduits installed in all outdoor locations, corrosive areas and vaults shall be PVC-GRC. PVC-GRC conduit with damaged PVC coating shall be replaced. Repair is unacceptable.

C. Hazardous Locations

1. Within all Class 1, Division 1 Hazardous Locations, provide conduit seal offs and boxes and fittings listed for Class 1, Division 1 Hazardous Locations per the NEC.

2. Flexible connections to motors within a Hazardous Location shall be made with a Hazardous Location Flexible Coupling. Lengths shall not exceed three (3) feet.

D. Conduit Sealing and Drainage

1. Provide conduit drains installed as shown on the Drawing details and in conduit systems as identified on the Drawings. Discuss the installation details with the ENGINEER before underground conduits are covered. Changes that may become necessary in the conduit system resulting from a lack of coordination with the ENGINEER prior to covering underground conduits shall be completed by the CONTRACTOR at no additional expense to the OWNER.

2. Conduit drainage and sealing other than required for hazardous and classified areas:

a. Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above grade conduit runs at the points at which the conduit enters buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.

b. Provide seal fittings with drains in vertical drops directly above grade for exterior, above grade conduit runs that are extended below grade.

c. Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:

1) Where portions of an interior raceway pass through walls, ceilings or floors that separate adjacent areas having widely different temperatures.

d. Provide conduit seals similar to O/Z Gedney (Type CSM) on all conduits between corrosive and non-corrosive areas.

e. Seal one end only of all underground conduits at highest point with O/Z Gedney sealing (non-hazardous) filling, or equal.

3. Install seals with drains at any location along conduit runs where moisture may condense or accumulate. This requirement includes, but is not limited to, the following locations: control panels, junction boxes, pullboxes, or low points of conduit.

4. All conduits which enter/leave a building shall be sloped away from the building to prevent the accumulation of water within the building.

5. All conduits which enter/leave a building shall be sealed with an approved duct seal.

E. RAC Installation

1. RAC that passes through concrete walls shall be protected against corrosion using bitumastic tape wrap. Install bitumastic paint per manufacturer's instructions.

2. RAC shall not be installed directly in contact with concrete. Utilize strut channel to maintain separation between the conduit and concrete.

3. RAC shall not be installed in concrete or direct buried.

4. RAC shall be installed using aluminum strut and straps as identified in 260500 Plant Area Work Requirements. Where stainless steel strut and straps are required, install bitumastic tape around the RAC conduit to prevent the aluminum from making contact with the stainless steel.

F. EMT Conduit Installation

1. EMT Conduit shall be installed only where permitted as described within 260500 Plant Area Work Requirements.

2. EMT shall not be used in the same conduit run that utilizes RAC.

G. Dissimilar metals

1. Provide corrosion protection tape around conduits that are dissimilar material than the hardware material, such as rigid aluminum conduit and stainless steel hardware. Conduits and hardware that are dissimilar metals shall not be installed

in direct contact of each other. Tape shall be 20 mil thick. Wrap shall be 50% overlap minimum. The wrap shall extend 1/4" minimum beyond the edge of the strap, strut, or fitting.

H. Underground Conduit Installation

1. Underground conduits shall be PVC except as specifically noted differently elsewhere.

2. Conduits routed under a concrete slab shall be routed under the vapor barrier. The conduits shall be routed deep enough so the radius of the conduit stubbed up through the slab is completely below grade. The vapor barrier shall be sealed at every point a conduit penetrates the barrier as per the requirements specified for the vapor barrier.

3. All power conduits routed to or from an adjustable frequency drive or a variable frequency drive shall be metallic conduit. Where routed underground these conduits shall be PVC-GRC type conduit.

4. Underground conduits shall be routed as shown on the Drawings.

5. Power conduits shall be separated from all other conduits by a minimum of 12 inches and when required to cross other conduits it shall be done at a 90 degree angles.

6. Conduit bends greater than 45 degrees shall utilize PVC-GRC conduit for the bend.

7. Conduit runs stubbed out of concrete shall make a transition to PVC-GRC at least six (6) inches before leaving the encasement.

8. Conduits routed in structural concrete shall be routed in such a manner as to not interfere with the structural integrity of the concrete. The ENGINEER shall approve CONTRACTOR's proposed conduit routing before installation. It is the CONTRACTOR's responsibility to coordinate conduit routing with the ENGINEER well before it is scheduled to be installed. Conduits shall be stubbed up directly under the enclosure or device their will serve. The CONTRACTOR is responsible to coordinate with the other trades prior to installation of raceways. Lack of coordination shall not be justification for extra compensation and removal and re-installation of conduits to resolve conflicts shall be done at the CONTRACTOR's expense.

9. Where conduits are stubbed up out of a concrete floor or slab, the PVC-GRC conduit shall extend two (2) inches above finished floor or grade including housekeeping pads before transitioning to any other type of conduit.

10. Underground conduit shall have a minimum of 24 inches of cover unless specifically called out differently on the Drawings.

11. Conduits for the local Utilities shall be of the conduit type they specify, which may or may not include HDPE or fiberglass.

12. Conduits routed from or to buildings or structures shall be concrete encased unless specifically called out differently on the Drawings.

I. Concrete Encased Conduit Installation

1. Concrete encased duct banks shall include the duct spacers, rebar, copper ground conductor and any other items called out on the Drawing detail. Concrete for duct banks shall be 3,000 PSI minimum with red powered dye sprinkled generously on top of the concrete after pouring and before it begins to set-up.

2. Conduit duct spacers shall be installed for all concrete encased conduits and the spacers shall be raised off the bottom of the trench with 1.5 inch minimum concrete dobies. The spacers shall be space no more than 60 inches linearly and joints in each horizontal layer of conduits shall be staggered a minimum of 12 inches from the layer above and below.

J. Miscellaneous

1. Provide cord grip for any unsupported cord.

3.02 BOX INSTALLATION

A. General.

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

2. Install boxes and enclosures in accordance with the schematic representation as indicated on the Drawings.

3. Boxes and enclosures shall be mounted level and plumb.

4. Boxes and enclosures shall not be altered, holes drilled, etc. in any way that may compromise the NEMA rating of the enclosure or box.

5. Boxes and enclosures shall be mounted with stainless steel hardware.

6. Boxes and enclosures shall be bonded to the equipment grounding conductor.

7. Surface mounted enclosures and boxes shall be spaced off the surface at least ¼ inch in damp or wet locations.

8. Boxes and enclosures with threaded hubs or punched holes shall have the opening match the conduit size. The use of reducing bushings or reducing washers is unacceptable.

9. Galvanized cast iron boxes are permitted only where GRC conduit is permitted.

10. PVC-coated boxes shall be used wherever PVC-GRC conduit is required.

11. Enclosures shall be provided whenever a junction or pull box larger than 4 inches square is required.

12. Provide a divider whenever a box contains conductors of different potentials that the code requires separation.

13. Install vaults and in-ground box tops (lids) such that they are ½ inch above finished grade to prevent water ingress.

14. Conduits entering or exiting vaults shall do so at via the precast ducts or knock-outs only. Conduits shall not enter or exit through the floor or any other area not design specifically for that purpose and pre-approved by the ENGINEER.

15. Wherever conductors smaller than # 1 AWG are routed through a vault, the conductors shall be encased in non-metallic flexible conduit such as ENT where they are inside the vault. The ENT shall be routed on the cable support arms and securely fastened.

16. Cable support arms shall be installed in vaults on a spacing not to exceed 2' – 0" on center. Cables and or ENT shall be secured side by side to the cable support arms via tie-wraps. Cables or ENT shall be the same length in the vaults and shall be routed around the interior walls of the vault. The cables/conductors shall make a minimum of one complete (360 degree) circle in the vault before exiting through another conduit.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for identification of electrical, safety, measurement, data, fire alarm, security, monitoring, control and related components and equipment.

1.02 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 26000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

A. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

C. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. The initial submittal shall contain all the products, samples and data base specified. An initial submittal that does not contain all the specified data shall be returned as incomplete.

D. Samples

1. Provide a sample of each type and size of nameplate, label, tag and means of attachment specified for approval by the OWNER.

E. Quality Assurance / Quality Control Submittals

1. The CONTRACTOR shall be responsible for submitting a data base of all identification nameplates, labels, panel schedules and tags required for the Work. The data base shall be developed in the most current edition of Microsoft Excel for the OWNER's future use.

F. Closeout Submittals

1. As-built electronic copy of the identification Excel data base.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Circuit Breaker Panel Schedules (260553.S21).

1. Shall be created in Microsoft Excel software. One copy of each schedule shall be included in the closeout submittals.

2. Shall be printed on 60 - 70 lb white card stock.

B. Heat Sealing Lamination Products (260553.L11).

1. Provide documents in laminate when specified. Laminate shall be clear, non-yellowing and sized for various sized documents.

2. Shall be 5 mil in thickness.

C. Plastic Nameplates (260553.P05).

1. Shall have a black background with white engraved letters. Nameplates for emergency functions shall be red background with white engraved letters. The nameplates shall have self adhesive rated for the environment which they are installed. The font type shall be consistent on all nameplates.

2. Provide products supplied by E.R. Perry Signs & Engraving, or approved equal.

D. Stainless Steel Nameplates (260553.S15).

1. Shall be 316 or 304 stainless steel.

2. 1.5 inches high by 6.0 inches long minimum.

3. The nameplate shall be between .025 - .050 inches thick.

4. Text shall be as large as possible, shall be center justified and shall be stamped.

5. The stainless steel nameplate shall be attached with stainless steel rivets. No less than four (4) rivets shall be used to securely fasten the nameplate.

6. Provide products supplied by E.R. Perry Signs & Engraving, or approved equal.

E. Stainless Steel Component and Device Tags (260553.S25).

1. Shall be stainless steel.

2. Two (2) inch round.

3. The tag shall be between .025 - .050 inches thick.

4. The text shall be center justified and shall be stamped.

5. Standard size for characters shall be 0.25 inches high.

6. The stainless steel tags shall be attached to devices with stainless steel beaded chain which shall be provided with two (2) to three (3) inches of slack when the tag is attached to the device. The hole in the tag for the beaded chain shall be at the top and centered on the tag. The hole shall be large enough that the chain will not bind in the hole.

7. Provide products supplied by E.R. Perry Signs & Engraving, or approved equal.

F. Conduit Tags (260553.S35).

1. Shall be 316 or 304 stainless steel.

2. Nominally 0.75 inches high by 3.0 inches long.

3. Characters shall be 0.25 inches high. And shall be machine punched or durably embossed.

4. Conduit tags shall be products readily available and manufactured for this purpose.

5. The stainless steel conduit tags shall be attached with stainless steel cable ties.

6. Provide Panduit Permanent Identification System products, or approved equal.

G. Epoxy Gel (260553.E05).

1. Shall be a two component, 100 % solids, moisture tolerant, high modulus, high strength, structural epoxy paste adhesive.

2. Provide Sika type Sikadur 31, Hi-Mod Gel, or approved equal.

H. Conduit Trench Marker Tape (260553.T21).

1. Shall be a minimum of six (6) inches wide, polyethylene tape manufactured for this purpose.

2. Color code for tape shall be as listed below and the verbiage on the tape shall identify the type of system i.e. “Caution Buried Electric Line Below”.

   a. Electric Power – RED

   b. Fiber Optic – ORANGE

   c. Data/Phone – ORANGE

   d. Control – ORANGE

3. Provide products manufactured by Seaton Identification Products, Harris Industries, or approved equal.

I. Conductor and Cable Identification Sleeves (260553.T31).

1. The identification sleeves shall be properly sized for the cable or conductor.

2. Sleeves shall be white with black machine generated characters.

3. Provide Brady wire and cable sleeves, or approved equal.

J. Flexible Identification Tape (260553.T56).

1. Shall be white, red, yellow, clear or as otherwise specified tape with black characters.

2. Standard tape size shall be 0.5 inch high unless specified otherwise and shall have extra strength adhesive rated for indoor and outdoor use.

3. Provide products manufactured by Brother, or approved equal.

K. Colored Tape (260553.T73).

1. Shall be rated for adhesion to steel and PVC conduits.

2. Shall be two (2) inches wide nominal and available in the colors specified.

3. Shall have extra strength adhesive rated for indoor and outdoor use.

4. Color code for tape shall be as listed below.

   a. Fire Alarm / Life Safety - RED

   b. Fiber Optic – ORANGE

   c. IT Data/Phone – BLUE

   d. Generator power – ORANGE

5. Provide DUCK, 3M, or approved equal.

L. Arc Flash Labels (260553.A11).

1. Reference Section 26 05 73 – Overcurrent Protective Device Coordination Study for additional details.

2. Shall be self adhesive and manufactured specifically for this purpose.

3. Shall be four (4) inches high by six (6) inches wide minimum.

4. Shall be based on the latest edition requirements of the National Fire Protection Association (NFPA) 70E – Standard for Electrical Safety.

5. At a minimum the label shall contain the following information.

   a. Date calculation was performed and who did the calculation.

   b. Danger or Warning level based on the incident energy. When above 40 cal/cm sq. the label shall read “Danger”.

   c. Shall identify the hazard as being both arc flash and shock hazard.

   d. Shall clearly state the incident energy and the level of personal protective equipment (PPE) required.

   e. Provide labels manufactured by Dura Label, SKM System Analysis, Inc., or approved equal.

M. Conductor Color Coding (260553.C89).

1. Conductors shall be colored as specified in the table below. The technical specification requirements for the conductors are specified elsewhere.

Conductor Color Coding

System	Conductor	Color
All Systems	Equipment Grounding	Green
IT / Data	Data Cable Sheath (outer cover)	Blue
24 Volt DC	Positive	Blue
	Negative	White w/ Blue Stripe
	Discrete Input Line (hot leg) Side	Blue
	Discrete Input Switch Leg	Blue w/ White Stripe
	Discrete Output Line (hot leg) Side	Blue
	Discrete Output Switch Leg	Blue w/ Orange Stripe
24 Volt AC	Hot Leg	Red
	Neutral	White
	Discrete Input Line (hot leg) Side	Red
	Discrete Input Switch Leg	Red w/ Blue Stripe
120 Volt AC Control	Hot Leg	Red
	Neutral	White
	Discrete Input Line (hot leg) Side	Red
	Discrete Input Switch Leg	Red w/ White Stripe
	Discrete Output Line (hot leg) Side	Red
	Discrete Output Switch Leg	Red w/ Orange Stripe
120/240 Volt Single Phase	Hot Leg # 1	Black
	Hot Leg # 2	Red
	Neutral	White
120/208 Volt Three Phase	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral	White
120, 208, 277 Volt	Switch Legs	Pink
480 Volt Three Phase	Phase A	Brown
Wye or Delta Corner Tap	Phase B	Purple
	Phase C	Yellow
	Neutral	Gray
120/240 Delta Three Phase	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral	Gray

PART 3 - EXECUTION

3.01 INSTALLATION

A. Circuit Breaker Panel Schedules

1. CONTRACTOR shall request panel schedules in Microsoft Excel software and printing instructions from ENGINEER. CONTRACTOR shall update the panel schedules to reflect as-built conditions. Print schedules on 60 - 70 lb white card stock with black ink.

2. Schedules shall be neatly trimmed with 1/8" white space borders.

3. The finished schedules shall be laminated and neatly trimmed with 1/8" of laminate border.

4. A sample layout shall be submitted to OWNER for approval prior to installation.

5. Attach white Velcro to the panel door and the back of the panel schedule. Velcro shall, at a minimum, be attached to all four corners of the panel schedule.

B. Plastic Nameplates

1. Provide plastic nameplates for panelboards, motor control centers, motor starters, disconnects, variable frequency drives, control panels and similar equipment. The verbiage on the nameplate shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.

2. In addition to the nameplate identifying the equipment, a second nameplate shall be provided that identifies the source of power for the equipment i.e. “Fed From PNL208-1”.

3. Typically the nameplates shall be centered and installed near the top of the equipment.

4. Nameplates shall be black with white characters unless specified otherwise.

5. Nameplates on emergency panels shall be red with white characters.

C. Stainless Steel Nameplates

1. Provide stainless steel nameplates for in-ground boxes, cast-in concrete boxes, electrical boxes larger than four (4) inches in any direction, boxes installed outdoors and vaults.

2. The nameplates shall be installed on the lid/cover and attached with 1/8 inch, stainless steel rivets in all four corners at a minimum.

3. The verbiage on the nameplate shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.

D. Stainless Steel Component and Device Tags

1. Provide stainless steel component and device tags for instruments, valves, pipes and similar equipment.

2. The tag shall be attached with a stainless steel beaded chain and attached in a manner and location which enables it to be read without interfering with the operation of the component or device. Whenever possible it shall not be attached to a removable part of the equipment.

3. The verbiage on the tag shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.

E. Conduit Tags

1. Provide stainless steel conduit tags at each point that a conduit terminates at or within an enclosure or box. The stainless steel tag shall be attached with stainless steel cable ties.

2. Where conduits enter a vault and are installed flush with the walls, the conduit tag shall be installed directly above the conduit entry and attached to the wall of the vault with epoxy gel.

3. The verbiage on the tag shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available on the Contract Drawings.

4. Where conduits terminate at a box in an inaccessible location such as behind a sheetrock wall, conduit labels are not required.

F. Conduit Trench Marker Tape

1. Provide conduit trench marker tape for single or multiple buried conduits. The color and verbiage shall match the type of system installed. If the trench contains several systems, one of which is electric power, the tape shall be for electric power.

2. The tape shall be installed 12 inches below finished grade and shall be laid flat and parallel to the conduits.

G. Conductor and Cable Identification Sleeves

1. Provide heat shrink, machine generated, white labels with black characters for all cables and conductors. Explanation is provided below on how various systems shall be identified. In many cases the information necessary to develop the unique identification labels will be provided on the Contract Drawings. The verbiage required for the identification shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available or clear based on the information provided on the Contract Drawings.

2. The labels shall be installed between 6 to 8 inches from the end and shrunk. Conductors shall be labeled at all splices and points of termination.

3. Power conductors and cables, including the neutral and the ground conductors shall all be identified individually. The identification label will be developed as follows: The first set of characters will be the equipment code identifying the source of power “PNL208” followed by the circuit number “CKT 12” and a forward slash followed by the room number where the utilization is located and then the

utilization equipment. Using the first sequential unit heater in room 2334 as an example, the label would read “PNL208-CKT 12/ 2334-UH-1”.

4. Control conductors, including grounds, shields, etc. shall be identified individually. The label shall identify the point of origin and the utilization equipment it serves. The identification label will be developed as follows: An sample label for a conductor fed from terminal strip 2, terminal block 33 in control panel # 1 (CP-1) to an terminal strip 1, terminal block 4 in automatic transfer switch # 1 (ATS-1) would read CP-1 TS2-TB33 / ATS-1 TS1-TB4.

5. Security conductors and cables shall be identified in the same manner as control conductors.

6. Fire alarm and life safety conductors and cables shall be identified in the same manner as control conductors.

7. Direct Digital Control (DDC) conductors and cables shall be identified in the same manner as control conductors.

8. Local Area Network (LAN) cables shall be identified with the rod mount number, highband number and the network room number from which it is connected. The verbiage required for the identification shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available or clear based on the information provided on the Contract Drawings.

9. Telephone, cameras, speakers and other IP cables connected to the LAN shall be identified in the same manner as the LAN cables.

H. Device and Faceplate Identification Labels

1. Devices, faceplates, security devices, fire alarm & life safety devices, small electrical boxes 4 inches or less located indoors and similar equipment shall be identified utilizing flexible identification tape. Typically the CONTRACTOR shall provide machine generated, white labels with black characters except as specified otherwise. Explanation is provided below on how various systems shall be identified. In many cases the information necessary to develop the unique identification labels will be provide on the Contract Drawings. The verbiage required for the identification shall be as identified on the Contract Drawings. The CONTRACTOR shall request the required verbiage from the ENGINEER should it not be available or clear based on the information provided on the Contract Drawings.

2. LAN faceplates and device shall be identified in the upper information window by the network room number that serves it. Each data jack shall be labeled individually and the label shall include the rod mount and highband number. An individual data jack fed from rod mount 2, highband 34 would read “2.34”.

3. Power receptacles faceplates (cover plates) shall state the panel and circuit number. A typical label might read “PNL208-1-CKT 15”.

4. Light switches faceplate shall state the panel and circuit number(s). A typical label might read “PNL208-2-CKT 15&17”.

5. Light fixture labels shall be attached adjacent to the ballast and shall follow the same requirements of listing the panel and circuit number. A typical label might read “PNL480-1-CKT 9&11”.

6. Interior emergency light fixtures shall have a unique 0.5 inch adhesive dot applied to facilitate tracking routine maintenance required for emergency lighting. The dots shall be red when they have an integral battery back-up and orange when fed from an emergency panel powered by a generator.

7. Exterior light fixtures shall be uniquely identified to facilitate tracking of routine maintenance. The identification shall be shown on the Contract Drawings. The identification label will be developed as follows: The first set of characters will be the facility code “SLC-012” followed by the equipment code “LGT” and then a sequence number such as“14”. A typical label might read “SLC-012-LGT-14”. The labels shall be self adhesive, yellow vinyl with black characters. The label shall be installed on the bottom of the fixture when mounted 5 feet above finished grade (AFG) or higher and on the top when mounted lower than 5 feet. Labels shall be 0.5 inches high with 0.375 inch characters when mounted lower than 10 feet AFG. Labels shall be 0.75 inches high with .0.5 inch characters when mounted between 10 and 20 feet. Labels shall be 1.0 inches high with .0.75 inch characters when mounted higher than 20 feet AFG.

8. Security Cameras, keypads, door switches, motion detectors, etc. shall be identified as shown on the Contract Drawings. The identification label will be developed as follows: The first set of characters will be the facility code “SLC-061” followed by the room number (2334) and then the equipment code “KEY” and lastly by a sequential number such as “21”. A typical label might read “SLC-061-2334-KEY-21”.

9. Fire alarm / life safety devices such as pull stations, door magnets, horns, beacons, etc. shall be identified as shown on the Contract Drawings. The identification label will be developed as follows: The first set of characters will be the facility code “SLC-032” followed by the room number (2334) and then the equipment code “PS” and lastly by a sequential number such as “11”. A typical label might read “SLC-032-2334-PS-11”.

10. Direct digital control components and accessories such as dampers, actuators, VAV, etc. shall be identified as shown on the Contract Drawings. The identification label will be developed as follows: The first set of characters will be the facility code “SLC-007” followed by the room number (2334) and then the equipment code “VAV” and lastly by a sequential number such as “43”. A typical label might read “SLC-007-2334-VAV-43”.

I. Colored Tape

1. Colored tape shall be installed on conduits used for the systems listed below. The tape shall have extra strength adhesive rated for indoor and outdoor use and two (2) inches wide. CONTRACTOR shall install a single wrap around the circumference of the conduit at five (5) foot intervals. In addition the exterior of junction or pull boxes installed along these raceways shall be painted entirely with 2 coats of paint that matches the tape color.

a. Fire alarm / life safety – RED

b. Data / IT – BLUE

c. Fiber Optic – ORANGE

d. Generator power routed to or from emergency panels – ORANGE

J. Arc Flash Labels

1. The CONTRACTOR shall install arc flash labels on all electrical equipment as required by the NEC and National Fire Protection Association (NFPA) 70E – Standard for Electrical Safety. The minimum requirements for the labels are itemized in PART 2 Products.

2. The CONTRACTOR shall be responsible for providing the coordination study and arc flash analysis necessary to calculate the incident energy and personal protective equipment (PPE) data required on each label.

3. An as-built coordination study and arc flash analysis shall be prepared at the Contractor's expense and be performed by a Professional Engineering licensed in the State of Oregon. The calculations shall utilize SKM Power Tools software and an electronic and hard copy shall be submitted to the Owner for approval. Arc Flash Labels with all data specified by the current edition of the NFPA 70E (Standard for Electrical Safety) and Occupational Safety & Health Administration (OSHA) shall be provided by the Contractor.

4. The CONTRACTOR is responsible to make the adjustments to the protective devices and circuit breakers as specified in the coordination study.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. The section includes the requirements for a Short-Circuit Study, Protective Device Coordination Study, Arc Flash Study, and Arc Flash Warning Labels.

1.02 REFERENCES

A. Referenced Standards:

1. American National Standards Institute (ANSI).
2. Institute of Electrical and Electronics Engineers (IEEE):
   a. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
   b. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
   c. 1584, Guide for Performing Arc Flash Hazard Calculations.
3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
4. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70E, Standard for Electrical Safety in the Workplace.
5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910, Subpart S, Electrical.

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Product Data:

1. Pursuant to 01 33 00 Submittals.

2. Arc Flash Warning Label templates.

1.04 QUALITY ASSURANCE

A. Short circuit, protective device coordination, and arc flash studies shall be provided by a corporately and financially independent, unbiased, testing authority. The testing authority shall be independent of manufacturers, suppliers, and installers of equipment being tested. The testing authority shall have a minimum of five (5) years experience testing similar projects.

1.05 SEQUENCING AND SCHEDULING

A. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.

B. Revised short circuit, protective device studies, arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.

C. Final short circuit, protective device studies, and arc flash studies shall be completed prior to project completion. Final version of study shall include as-built equipment, materials, and parameter data or settings entered into equipment based on study.

D. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to project completion.

PART 2 - STUDIES AND PRODUCTS

2.01 SHORT CIRCUIT STUDY

A. General

1. Prepare a Short Circuit Study in accordance with IEEE 39.

2. Cable impedances shall be based on copper conductors.

3. Bus impedances shall be based on copper buses.

4. Cable and bus resistances shall be calculated at 25 degrees Celsius.

5. Medium voltage cable reactance shall be based on typical dimensions for standard cables with 133% insulation levels.

6. 600-volt cable reactance shall be based on the typical dimensions of THWN-2 conductors.

7. Transformer impedances shall be 92.5% of nominal impedance based on tolerances specified in IEEE C57.12.00.

B. The Short Circuit Study final report shall include the following:

1. Basic description, purpose, and scope of the study.

2. Descriptions of the scenarios evaluated and identification of the scenario used to evaluate short circuit ratings.

3. Explanation of bus and branch numbering system.

4. Prevailing conditions.

5. Selected base per unit quantities.

6. Source impedance data, including electric utility system, generator, and motor fault contribution characteristics.

7. Impedance diagrams.

8. Zero-sequence impedance diagrams.

9. One line diagrams and associated tabulations of data used to model the system components.

10. Calculation methods and assumptions.

11. Typical calculations.

12. Tabulation of calculation quantities.

13. Results, conclusions, and recommendations.

C. The short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault shall be calculated at each:

1. Utility Service point.

2. Medium Voltage Switchgear.

3. Low Voltage Switchgear.

4. Switchboard.

5. Motor Control Center.

6. Automatic Transfer Switch.

7. Distribution Panel.

8. Branch Circuit Panelboard.

9. Future load contributions as shown on the One-Line Diagram.

10. Any additional point within the power distribution system as specified by the Engineer.

D. The Short Circuit Study shall be used to verify the following:

1. Equipment and protective devices are applied within their ratings.

2. Adequacy of distribution equipment bus bars to withstand short circuit stresses.

3. Cable and bus way sizes for ability to withstand short circuit heating, in addition to normal current loads.

E. Provide a tabulation of equipment short circuit versus available fault duties. The tabulation shall identify percentage of rated short circuit current and clearly identify equipment with insufficient ratings.

1. General Data

a. Short circuit reactance of rotating machines.

b. Cable and conduit material data.

c. Bus data.

d. Transformer data.

e. Circuit resistance and reactance values.

2. Short Circuit Data

a. Fault impedances.

b. X/R ratios.

c. Asymmetry factors.

d. Motor contributions.

e. Short circuit kVA.

f. Symmetrical and asymmetrical fault currents.

3. Equipment Evaluation

a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway.

b. Maximum fault current available.

F. Provide a written summary at the end of the Short Circuit Study, which shall include the following:

1. Selected equipment deficiencies.

2. Results of short circuit study.

3. Conclusions and recommendations.

G. The Contractor shall be notified in writing of existing circuit protective devices improperly rated for new fault conditions.

H. The Short Circuit Study data shall be revised for as-built conditions.

2.02 PROTECTIVE DEVICE SETTINGS STUDY

A. General

1. The Protective Device Settings Study shall be used to determine recommended circuit breaker settings that provide a balance between equipment protection and selective device operation that is optimum for the electrical system. Provide an analysis of all possible operating scenarios which will be or have been

influenced by the proposed or completed additions or changes to the system. The study shall be prepared in accordance with ANSI/IEEE 399 and ANSI/IEEE 242.

B. The Protective Device Settings Study shall include the following:

1. Basic description, purpose, and scope of the study.
2. Descriptions of the scenarios evaluated and identification of the scenario used to evaluate short circuit ratings.
3. Prevailing Conditions.
4. One Line Diagrams.
5. Explanation of bus and branch numbering system.
6. Calculation methods and assumptions.
7. Typical calculation.
8. Tabulation of calculated quantities.
9. Time-current curves for overcurrent protection devices.
10. Results, conclusions, and recommendations.

C. The Protective Device Settings Study shall be used to verify the following protective device time-overcurrent settings:

1. Long Time Delay Pick Up.
2. Long Time Delay.
3. Short Time Delay Pick Up.
4. Short Time Delay.
5. Instantaneous Trip.
6. Ground Fault Pick Up.
7. Ground Fault Delay.
8. Current Transformer (CT) Ratios.
9. Time-Dial Multiplier.
10. Tap Settings.

D. Tabulation of calculated data shall include the following:

1. General Data
    a. Overcurrent protection device location, manufacturer, type, range of adjustment, IEEE device number, CT ratio.
2. Equipment evaluation
    a. Recommended settings or device size.
    b. Referenced time-current curve.

E. Provide a written summary at the end of the Protective Device Settings Study, which shall include the following:

1. Selected equipment deficiencies.
2. Results of coordination study.
3. Conclusions and recommendations.

2.03 ARC FLASH STUDY

A. Perform an Arc Flash Hazard Study after short circuit and protective device setting recommendations have been completed, reviewed, and accepted by the Engineer. Perform the analysis under worst-case arc flash conditions for all modes of operation. Provide an analysis of all operating scenarios which will be or have been influenced by the proposed or completed additions to the subject system.

B. The Arc Flash Hazard Study shall be performed in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.

C. The Arc Flash Hazard Study shall include the following:

1. Basic description, purpose, and scope of the study.
2. One Line Diagram.
3. Short Circuit Study.
4. Protective Device Settings Study.
5. Calculation methods and assumptions.
6. Typical calculation.
7. Evaluation summary spreadsheet.
8. Conclusions and recommendations.

D. Base Calculation: For each major part of the power distribution system, the following shall be determined:

1. Flash hazard protection boundary.
2. Limited approach boundary.
3. Restricted approach boundary.
4. Prohibited approach boundary.
5. Incident energy level.
6. Personal protection equipment (PPE) hazard/risk category.
7. Type of PPE required.

E. Produce arc flash warning labels that list items in Part C above and provide the following additional items:

1. Bus name.
2. Bus voltage.

F. Produce detail sheets that list items in Part C above and the following items:

1. Bus name.

2. Upstream protective device name, type, and settings.

3. Bus-to-line voltage.

G. Produce arc flash evaluation summary sheet listing the following additional items:

1. Bus name.

2. Upstream protective device name, type, and settings.

3. Bus-to-line voltage.

4. Protective device bolted fault current.

5. Arcing fault current.

6. Protective device trip/delay setting.

7. Breaker opening time.

8. Solidly grounded column.

9. Equipment type.

10. Gap.

11. Arc flash boundary.

12. Working distance.

13. Incident energy.

14. Required protective fire rated clothing type and class.

H. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 40 cal/cm2. Provide proposals to reduce energy levels.

I. Provide a written summary at the end of the Arc Flash Hazard Study, which shall include the following.

1. Equipment manufacturer's information used to prepare study.

2. Assumptions made during study.

3. Copy of one line diagram.

4. Arc flash evaluations summary spreadsheet.

5. Bus detail sheets.

6. Arc flash warning labels printed in color on adhesive backed labels.

2.04 ARC FLASH WARNING LABELS

A. Provide arc flash warning labels per NEC 110.16

B. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems

PART 3 - EXECUTION

3.01 GENERAL

A. Adjust relay and protective device settings according to reduce arc flash while maintaining coordination between downstream circuit breakers and the upstream main circuit breaker.

B. Perform minor modifications to equipment as required to accomplish conformance with short circuit study.

C. Notify Contractor in writing of required major equipment modifications.

D. Provide laminated one-line diagrams (minimum size 11” x 17”) to post on interior of electrical room doors.

E. Provide arc flash warning labels on equipment as specified on this Section.

END OF SECTION

SECTION 26 05 83

WIRING CONNECTIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. This Section includes requirements for conductor termination methods.

2. Additional conductor termination means and methods are specified in Section 40 63 00 Control System Equipment, Section 40 70 00 Instrumentation for Process Systems, Section 40 72 00 Level Measurement, and Section 40 78 00 Panel Mounted Equipment.

1.02 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 26000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Small Compression Connectors (260583.C01).

1. Insulated fork, ring or splicing (butt) connectors shall be provided for # 10 AWG or smaller conductors that splice together or terminate with a screw other than in a terminal block.

2. Connectors shall be properly sized for the conductor and for the stud used.

3. Burndy, Panduit, Thomas and Betts, or approved equal.

B. Insulated Wire Ferrules (260583.F10).

1. For all conductors terminating on terminal blocks, install crimp-on, insulated plastic sleeve ferrules on each conductor. Install ferrules with a crimping tool provided by the ferrule manufacturer for that purpose.

2. Wire ferrules shall be color coded to match the DIN color code.

3. Weidmuller, Panduit, American Electric, Inc., or approved equal.

C. Medium and Large Compression Connectors (260583.C10).

1. Non-insulated copper compression connectors shall be provided for # 8 AWG and larger conductors.

2. The connector shall have a voltage and current rating equal to or exceeding the conductor.

3. The barrel shall be long enough to accommodate a minimum of two (2) circumferential crimps.

4. The connectors shall be properly sized for the conductor.

5. Burndy, Panduit, Thomas and Betts, or approved equal.

D. Electrical Spring Connectors (Wire Nuts) (260583.W01).

1. Provide properly sized spring connectors for the size and number of conductors spliced.

2. Ideal, 3M, Thomas and Betts, or approved equal.

E. Insulated Mechanical Multi-Tap Connectors (260583.M01).

1. Provide properly sized, insulated, mechanical, multi-tapped connectors for splices.

2. Burndy, Panduit, Thomas and Betts, or approved equal.

2.02 ACCESSORIES

A. Varnished Cambric Tape 260583.T30).

1. Varnished cambric insulating tape shall be bias cotton cambric fabric tape, oil primed and coated with high-grade yellow electrical insulating varnish.

2. The tape shall not contain any adhesives.

3. 3M – Scotch # 2510, or approved equal.

B. Electrical Tape (260583.T40).

1. General electrical tape shall be premium grade, all weather vinyl electrical insulating tape.

2. 3M – Scotch 33+, or approved equal.

C. Thin Wall Heat Shrink Tubing (260583.T01).

1. Thin walled heat shrink tubing shall be flame retardant and made of cross-linked polyolefin.

2. The tubing shall have a minimum operating temperature of – 55 to + 135 degrees Celsius.

3. Burndy, Panduit, or approved equal.

D. Heavy Wall Heat Shrink Tubing (260583.T10).

1. Thin walled heat shrink tubing shall be flame retardant and made of cross-linked polyolefin.

2. The inside diameter shall be coated with an adhesive sealant to protect against moisture and corrosion.

3. The tubing shall have a minimum operating temperature of – 55 to + 135 degrees Celsius.

4. Burndy, Panduit, or approved equal.

E. Heavy Wall Heat Shrinkable End Caps (260583.T20).

1. Heavy walled heat shrink tubing shall be flame retardant and made of cross-linked polyolefin.

2. The inside diameter shall be coated with an adhesive sealant to protect against moisture and corrosion.

3. The tubing shall have a minimum operating temperature of – 55 to + 135 degrees Celsius.

4. Burndy, Panduit, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.
2. Care shall be taken when terminating conductors to avoid kinking, cutting or puncturing the jacket or allowing contamination by grease, oil or water.
3. Care shall be taken when terminating conductors to properly support the conductors and to avoid undue pressure on the connector or utilization equipment.
4. Conductors shall be terminated by use of lugs, pressure type connectors wire nuts or terminal blocks. Wrapping conductors around a screw type terminal is not acceptable.
5. Insulate all connections and splices with Scotch 33+ tape and Scotchfill, pre-molded plastic covers, or heat shrink tubing and caps.
6. Compression connectors shall be installed using the tool and die provided by the same manufacturer as the connectors and as per their directions.
7. Compressions on connectors used for # 8 AWG conductors and larger shall have a minimum of two (2) circumferential crimps.
8. Indenter type crimps on compression connectors shall not be used on conductors larger than # 10 AWG.
9. Additional conductor termination means and methods including terminal blocks and control conductors are specified in Section 40 63 00 Control System Equipment, Sections 40 70 00 Instrumentation for Process Systems, Section 40 72 00 Level Measurement, , and Section 40 78 00 Panel Mounted Equipment.
10. Connectors shall be installed as per the manufacturer's directions.
11. Insulated wire ferrules shall be provided for conductors terminated on terminal blocks utilizing a crimping tool provided by the ferrule manufacture specifically for this purpose.
12. Where wire ducts in enclosures exist, conductors shall be grouped together and routed in the wire ducts and shall be fanned out to the terminals.
13. Wire nuts shall be used on conductors # 10 AWG or less and only for splicing conductors at light fixtures, at receptacles and motors. No other splicing of conductors with wire nuts are permitted unless specifically identified on the Drawings.
14. All spare conductors shall be identified individually, neatly coiled and fastened with cable ties. The coil shall be labeled to describe its origin. Spare conductors shall be left long enough to be neatly routed and terminate anywhere within the enclosure.

15. Conductors installed outdoors which are not terminated the same day, shall have heavy wall heat shrinkable end caps installed the same day they are pulled in. The end caps shall remain in place until the day they are terminated.

16. Heavy wall heat shrink tubing shall be installed over splices or over the barrel of connectors installed outdoors.

17. Thin wall heat shrink tubing shall be installed over splices or over the barrel of connectors installed indoors.

18. Thin wall heat shrink tubing shall be installed over twisted shielded pair cable where the cable is stripped back.

19. As connections are set with a torque wrench, a black felt marker shall be used to mark across the bolt, nut or screw indicating the torque has been set.

20. Insulated Mechanical Multi-Tap Connectors shall be utilized for splices located at in-ground lighting and power boxes. It may also be used for motor terminations.

B. Terminations For Motors.

1. Conductors sized # 10 AWG or less for phase conductors shall be connected with wire nuts set tight. The wire nuts shall be wrapped with premium grade electrical tape with a 50 percent overlap, installed in a clockwise rotation to hold the connector in place and to keep debris out of the connector.

2. The equipment grounding conductor shall be terminated on a lug identified for this use. If the motor is not supplied with a lug, a ring or compression type lug shall be used.

3. Conductors sized larger than # 10 AWG shall be terminated with compression connectors properly sized. The connectors shall be bolted together in a pigtail type fashion using stainless steel bolts, flat washers, lock washers and nuts. They shall have a torque as recommended by the bolt manufacturer for the bolt size used.

4. The bolt shall not be longer than the minimum necessary for the connection. The connectors shall be wrapped with varnished cambric tape with a 50 percent overlap covering the end of the connectors and extending one inch beyond the connector barrel. The varnished cambric tape shall be held in place by two layers of premium quality electrical tape, each layer with a 50 percent overlap.

5. Insulated Mechanical Multi-Tap Connectors may be used for motor terminations in lieu of the compression connectors and varnished cambric tape method.

6. Conductors shall be left as long as practical for termination in the motor terminal box.

END OF SECTION

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SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. Definitions

2. Requirements for commissioning.

1.02 DEFINITIONS

A. Commissioning Verification Period.

1. The commissioning period begins after the ENGINEER has approved the Functional Test Certification demonstration with the control software, the specified demonstration and training is complete, punch list deficiencies are corrected and the final operation and maintenance manuals are submitted and approved. The duration of the commissioning verification period is 14 days without significant interruption.

B. Significant Interruption.

1. Significant interruption may include any of the following events.

a. Failure of the CONTRACTOR to maintain qualified onsite start-up personnel as specified.

b. Failure of critical equipment unit, system, or sub-system that is not satisfactorily corrected within two (2) hours after the failure.

c. Failure of noncritical equipment unit, system, or sub-system that is not satisfactorily corrected within twenty-four (24) hours after the failure.

d. As may be determined by the ENGINEER.

1.03 REQUIREMENTS FOR COMMISSIONING

A. Commissioning of the facility shall be completed prior to substantial completion.

B. CONTRACTOR shall provide for realistic durations in the progress schedule for the commissioning activities.

C. Provide the labor, medium, chemicals, tools, equipment, instruments and services required for, and incidental to, completing commissioning.

D. Demonstrate satisfactory operation within the facility of the equipment and systems in actual operation as a functional unit.

E. Conduct commissioning for a period of fourteen (14) continuous days without significant interruption.

F. The commissioning verification period shall restart with the correction of each significant interruption.

G. Correct defects in material and workmanship immediately following their discovery.

H. Provide for maintenance until substantial completion. This includes the required maintenance activities during the commissioning verification period.

I. Perform maintenance pursuant to the operation and maintenance data requirements for the new facility during and following the commissioning verification period and prior to issuance of a certificate of substantial completion.

J. As of the date of substantial completion, OWNER's staff shall be responsible for operation and maintenance of the new facilities. This excludes any issues identified as warranty matters.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 26 21 00

LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 - GENERAL

1.01 SUMMARY

A. The Section includes electrical utility requirements and contact information.

1.02 SYSTEM DESCRIPTION

A. Electrical Service

1. The CONTRACTOR shall coordinate all work and inspections with the ENGINEER, the local jurisdiction having authority, Pacific Power (PP&L) (electric utility), and the OWNER.

2. The CONTRACTOR is responsible for all costs for this work including fees for permits, and fees for the electric utility.

3. The CONTRACTOR shall provide all necessary installation services that are not provided by the electric utility.

4. The CONTRACTOR shall provide all necessary components that are not provided by the electric utility. All components shall be as specified by the electric utility. Components include conduits, pull rope, vaults, pull boxes, transformer pads, current transformer cabinets, meter socket enclosures, bollards, and ancillary items.

5. The CONTRACTOR shall comply with the electric utility's electric service requirements.

B. Temporary Service.

1. The CONTRACTOR shall be responsible to coordinate work with the local electrical utility serving the facility.

C. Utility Information:

1. Pacific Power Project: # 8207796

2. Engineer: Elke Vath

3. Contact: elke.vath@pacificorp.com

PART 2 - PRODUCTS – NOT USED

PART 3 - INSTALLATION

3.01 QUALITY CONTROL

A. All work shall comply with the electric utility's electrical service requirements, electric utility's specifications, and the Contract Documents.

B. CONTRACTOR shall coordinate work with other trades to avoid conflicts, delays and unnecessary interference with operation of the facility during construction.

C. CONTRACTOR shall provide all materials and incidentals required for a complete and operable system, even if not indicated explicitly by the Contract Documents.

D. The routing of the conduit is critical and shall be coordinated with the utility, ENGINEER and OWNER.

END OF SECTION

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. Requirements for low voltage dry type transformers and their installation.

1.02 REFERENCES

A. The following is a list of Standards which may be referenced in this Section.

1. American National Standards Institute (ANSI).

a. C57.12.50 and C89.1 Ventilated Dry Type Power Distribution Transformers.

2. National Fire Protection Association (NFPA).

a. 70 – National Electrical Code (NEC).

3. National Electrical Manufacturers Association (NEMA).

a. ST.20 – Dry Type Transformers for General Application.

4. Underwriters Laboratory, Inc (UL).

a. 506 – UL Standard for Safety for Specialty Transformers.

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittal.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

3. Manufacturer's data including outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, impedance ratings, tap configurations, insulation type and temperature rise.

1.04 DELIVERY, STORAGE AND HANDLING

A. Acceptance at Site.

1. Verify nameplate data meets the specified requirements.

2. Store in a clean, dry space.

B. Storage and Protection.

1. Handle in accordance with the manufacturer's written instructions.

2. Lift only with lugs provided.

3. Handle carefully to avoid damage to transformers internal components, enclosure and finish.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Transformer (262200.T01).

1. Product description: DOE 2016, factory assembled, air-cooled, dry type transformers, ratings as shown on the Drawings.

2. Unit kVA and voltage shall be as shown on the Drawings.

3. Insulation system and average winding temperature rise for rated KVA shall be Class 220 with a 115 degree C rise.

4. Case temperature shall not exceed 30 degrees C rise above ambient temperature at warmest point at full load.

5. Sound level shall meet NEMA ST 20 Standard.

6. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

7. Units up to and including 112.5 KVA shall be suitable for wall or floor mounting.

8. Coil conductors shall be continuous aluminum windings with terminations brazed or welded.

9. Enclosure shall be NEMA 1 type unless specifically called out differently on the Drawings. Transformers shown outdoors shall be NEMA 3R.

10. Cooling shall be factory assembled air cooled type.

11. Isolate core and coil from enclosure using vibration-absorbing mounts.

12. Terminations shall be suitable for termination copper conductors without any special modifications.

13. Nameplate shall include transformer connection data and overload capacity based on rated allowable temperature rise.

14. The basis of design is for the manufacture specified. Any modifications to the design that may become necessary due to the approval of an "or equal" product shall be the responsibility of the CONTRACTOR.

15. Provide factory-installed noise and vibration isolation. The noise and vibration isolation shall consist of the following:

    a. Isolation bushings on transformer core for vibration isolation.

    b. Insulation on the interior of the enclosure of noise isolation.

    c. Vibration isolation feet.

    d. Rubber isolation pads shall be provided.

16. Provide Eaton model number DT-3, Siemens, Square D, or approved equal.

2.02 SEISMIC CERTIFICATION

A. Seismic Bracing Certification (262200.S01).

1. The Manufacturer shall provide a seismic certificate.

2. Contractor shall provide seismic anchor bolts for all transformers shown on the Drawings.

3. The seismic anchor bolts shall be designed by a licensed Structural Engineer in the State of Oregon. The Structural Engineer shall provide wet stamped and signed seismic calculations and drawings.

4. The seismic anchor bolt design shall comply with the Manufacturer's seismic requirements.

5. The Contractor shall provide transformer approved shop drawings to the Structural Engineer. The shop drawings shall indicate the weight and dimensions of the transformer. The Contractor shall provide any additional information required by the Structural Engineer to perform the seismic calculations.

2.03 ACCESSORIES

A. Transformer Isolation Pads (262200.P20).

1. Provide rubber isolation pads under the transformer at each anchor point. The product used shall be manufactured specifically for this purpose.

2. The pads shall be 1.0 inch thick minimum.

B. Wall Mount Brackets (262200.W01).

1. The transformer shall be mounted on the wall when shown as such on the Drawings.

2. The basis of design is for the manufacture specified. Any modifications to the design that may become necessary due to the approval of an “or equal” product shall be the responsibility of the CONTRACTOR.

3. The wall brackets shall be supplied by the manufacturer of the transformer and be rated for use with the transformer supplied.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

2. The wall bracket shall be anchored as recommended by the manufacturer and as shown on the Drawings, whichever is more stringent. The mounting shall be designed to withstand a seismic zone 4 event.

3. The transformer shall be connected to the grounding electrode system and treated as a separately derived system.

4. The transformer shall be set level and plumb.

5. Mount the transformer on isolation pads with a pad located at each anchor point.

6. Line and load conduits shall include a minimum of two (2) feet of LFAC flexible conduit.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. This section includes requirements for Low Voltage Switchboards.

B. The Switchboards listed on this project are OWNER Furnished, CONTRACTOR installed. CONTRACTOR shall coordinate with the OWNER and the OWNER's System Integrator to install the switchboards at the locations identified on the Drawings.

1.02 REFERENCES

A. The following is a list of Standards that may be referenced in the Section.

1. NEMA Standard PB 2 Deadfront Distribution Switchboards.

2. Underwriters' Laboratories (UL) Standard No. UL 891 Switchboards.

3. ANSI C37.90, Standard Relays and Relay Systems Associated with Electric Power Apparatus.

4. National Electrical Code (NEC).

1.03 DELIVERY, STORAGE, HANDLING

A. Equipment Handling

1. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.04 COMMISSIONING

A. Provide commissioning in accordance with Section 26 08 00.

PART 2 - PRODUCTS

2.01 SEISMIC BRACING

A. Provide seismic bracing for the swtichboards required by the International Building Code and Oregon Structural Specialty Code.

B. The design of the seismic anchoring and bracing system shall be by a licensed Structural Engineer in the State of Oregon. The CONTRACTOR shall arrange and pay for the services of the licensed Engineer.

C. Wet stamped and signed calculations and drawing of the seismic anchoring and bracing system shall be submitted to the Engineer for review and approval

D. Include Manufacturer's seismic certificate.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems

B. Installation shall be in accordance with the manufacturers' instructions.

C. The switchboard shall be mounted on a concrete equipment pad. The equipment pad shall be 4” high with a minimum 2” reveal on each side of the switchboard enclosure. The switchboard shall be arranged so that the uppermost operating handle shall not exceed 6 ft 6 in from the floor.

D. Field wiring shall be grouped by circuit and tie wrapped. Terminations shall not be stressed.

3.02 FIELD QUALITY CONTROL

A. Test and verify installation in conformance with Section 26 01 08.

B. In addition, make the following minimum tests and checks before energizing the equipment:

1. Megger terminals and buses at two times rated voltage, phase to phase and phase to ground after disconnecting devices sensitive to megger voltage.

2. Remove all current transformer shunts after completing secondary circuit.

3. Check all mechanical interlocks for proper operation.

4. Vacuum clean all interior equipment.

5. Adjust and test all circuit breakers and relays in accordance with Section 16080.

6. Confirm and record all protective relay settings.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. This Section includes the requirements for panelboards, mini-power centers, utility meter sockets and current transformer (CT) can.

1.02 REFERENCES

A. The following is a list of Standards which may be referenced in this Section.

1. National Fire Protection Association (NFPA).
   a. 70 – National Electrical Code (NEC).
2. National Electrical Contractors Association (NECA).
   a. 5055 - National Electrical Installation Standards (NEIS).
3. National Electrical Manufacturers Association (NEMA).
   a. AB 1 – Molded Case Circuit Breakers.
   b. KS 1 – Enclosed and Miscellaneous Distribution Equipment Switches (600 volts maximum).
   c. PB 1 – Panelboards
   d. PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
4. International Electrical Testing Association (NETA).
   a. Acceptance Testing Specifications.
5. Underwriters Laboratory, Inc. (UL).
   a. 50 – Enclosures for Electrical Equipment.
   b. 67 – Panelboards.
   c. 489 – Molded Case Circuit Breakers and Circuit Breaker Enclosures.

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example -

26000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.04 QUALITY ASSURANCE

A. Panelboards shall be manufactured in accordance with the Standards listed under 1.02 REFERENCES.

1.05 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be stored and installed in clean, dry and heated environment.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Distribution Panelboard (262416.P02).

1. Shall be rated as shown on the Drawings.

2. Shall be service entrance rated.

3. Shall have a NEMA 1 enclosure, painted gray and surface mount unless shown otherwise on the Drawings. Enclosure shall not have pre-punched conduit knockouts.

4. Front cover shall be provided with a door within a door configuration with continuous hinged doors that are lockable for both the inner access and the front door providing access to the circuit breakers. The dead front shall be attached to the access door such then when opened the dead front swings open with the door.

5. Main breaker shall have an available in-rush current (AIC) rating as shown on the Drawings. Branch circuit breakers shall have the same rating unless specifically shown otherwise on the Drawings.

6. Main breaker and feeder breakers shall be molded case, electronic trip or thermal magnetic as shown on the Drawings.

7. Where electronic trip units are shown, the units shall comply with the following:

    a. Microprocessor-based tripping system shall consist of three (3) current sensors, a trip unit and a flux-transfer shunt trip. The trip unit shall use microprocessor-based technology to provide the adjustable time-current protection functions. True rms sensing circuit protection shall be achieved by analyzing the secondary current signals received from the circuit breaker current sensors, and initiating trip signals to the circuit breaker trip actuators when predetermined trip levels and time-delay settings are reached.

    b. An adjustable trip setting dial mounted on the front of the trip unit shall establish the continuous trip ratings of each circuit breaker. Rating plugs shall be adjustable and settings shall be adjusted by the CONTRACTOR as indicated on the Drawings. Rating plugs shall be interlocked so they are not interchangeable between frames, and interlocked such that a breaker cannot be closed and latched with the rating plug removed.

    c. System coordination shall be provided by the following microprocessor-based time-current curve shaping adjustments.

        1) Adjustable long-time setting (set by adjusting the trip setting dial).

        2) Adjustable short-time setting and delay with selective curve shaping.

        3) Adjustable instantaneous setting.

        4) Adjustable ground fault setting and delay (where shown on the Drawings)

    d. The microprocessor-based trip unit shall have both powered and unpowered thermal memory to provide protection against cumulative overheating should a number of overload conditions occur in quick succession.

    e. When the adjustable instantaneous setting is omitted, the trip unit shall be provided with an instantaneous override.

8. Main breaker shall have an ampere rating as shown on the Drawings.

9. Feeder breaker capacity shall be as shown on the Drawings. Provide branch circuit breakers as shown on the Drawings.

10. Bus material shall be 100% tin plate aluminum rated for the voltage and ampere rating shown on the Drawings as a minimum.

11. Grounded conductor connection means shall be isolated, copper.

12. Grounding conductor connection means shall be copper.

13. Breakers shall be bolt-on type.

14. Provide three (3) 3-pole locks for the branch circuit breakers.

15. See the Drawings for additional data.

16. All panelboards and main breaker disconnects on the project shall be of the same manufacturer.

17. Provide arc flash labels compliant with the NEC, OESC and OSHA.

18. Provide integral, factory installed TVSS, IEEE C62.41 certified, 120kA per phase surge rating or higher. Coordinate voltage to match panel. Provide Eaton type SPD, or approved equal.

19. Provide Eaton Series Pow-R-Line 3a, Square D, Siemens, or approved equal.

B. Branch Panelboards (262416.B01).

1. Shall be rated as shown on the Drawings.

2. Shall have a NEMA 1 enclosure, painted gray and surface mount unless shown otherwise on the Drawings. Enclosure shall not have pre-punched conduit knockouts.

3. Front cover shall be provided with a door within a door configuration with continuous hinged doors that are lockable for both the inner access and the front door providing access to the circuit breakers. The dead front shall be attached to the access door such then when opened the dead front swings open with the door.

4. Main breaker shall have an available in-rush current (AIC) rating as shown on the Drawings. Branch circuit breakers shall have the same rating unless specifically shown otherwise on the Drawings.

5. Main breaker shall have an ampere rating as shown on the Drawings.

6. Branch circuit breaker capacity shall be as shown on the Drawings. Provide branch circuit breakers as shown on the Drawings.

7. Bus material shall be 100% tin plate aluminum rated for the voltage and ampere rating shown on the Drawings as a minimum.

8. Grounded conductor connection means shall be isolated, copper.

9. Grounding conductor connection means shall be copper.

10. Breakers shall be bolt-on type. No half sized breakers shall be permitted.

11. Provide two (2) 2-pole and two (2) single-pole locks for the branch circuit breakers.

12. See the panel schedule in the Drawings for additional data.

13. Provide arc flash labels compliant with the NEC, OESC and OSHA.

14. Where shown on the Drawings, provide integral, factory installed TVSS, IEEE C62.41 certified, 50kA per phase surge rating or higher. Coordinate voltage to match panel. Provide Eaton type SPD, or approved equal.

15. Provide Eaton Series Pow-R-Line 1a and Pow-R-Line 2a, Siemens, Square D, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems
2. Panels shall be grounded and bonded as shown on the Drawings and per the NEC whichever is more stringent.
3. Conductors shall be neatly grouped and routed within the enclosures.
4. Used and spare conductors shall be clearly identified as specified in Section 26 05 19.
5. Due to the number of conduits entering the panelboards it will be imperative that the CONTRACTOR plan the layout carefully so all the conduits fit in the bottom of the panelboards. Should a gutter be necessary, it shall be no deeper than the panelboards and only as wide as necessary to accommodate the conduits.
6. Provide typed circuit directory for each panelboard.
7. Install nameplates as shown on the Drawings and specified in Section 26 05 00.

END OF SECTION

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SECTION 26 24 19

MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. This section includes requirements for Low voltage (600 VAC or less) Motor Control Centers (MCC).

B. The Motor Control Centers listed on this project are OWNER Furnished, CONTRACTOR installed. CONTRACTOR shall coordinate with the OWNER and the OWNER's System Integrator to install the MCCs at the locations identified on the Drawings.

1.02 REFERENCES

A. The following is a list of Standards that may be referenced in the Section.

1. NEMA Standard ICS-2 Industrial Control and System Controllers, Contactors, and Overload Relays Rated 600 Volts.

2. NEMA ICS 3.1 - Safety standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.

3. NEMA 250 - Enclosures for Electrical Equipment.

4. Underwriters Laboratories (UL) Standard No. UL-508C Power Conversion Equipment.

5. Underwriters Laboratories (UL) Standard No. UL-845 Motor Control Centers.

6. American National Standards Institute ANSI C19.3 Compressors for Process Industries.

7. National Electric Code (NEC).

8. IEEE 519 - IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Equipment Handling

1. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.04 COMMISSIONING

A. Provide commissioning in accordance with Section 26 08 00.

PART 2 - PRODUCTS

2.01 THE MOTOR CONTROL CENTERS

A. The Motor Control Centers listed on this project are OWNER Furnished, CONTRACTOR installed. CONTRACTOR shall coordinate with the OWNER and the OWNER's System Integrator to install the MCCs at the locations identified on the Drawings

2.02 SEISMIC BRACING

A. Provide seismic bracing for the Motor Control Centers required by the International Building Code and Oregon Structural Specialty Code.

B. The design of the seismic anchoring and bracing system shall be by a licensed Structural Engineer in the State of Oregon. The CONTRACTOR shall arrange and pay for the services of the licensed Engineer.

C. Wet stamped and signed calculations and drawing of the seismic anchoring and bracing system shall be submitted to the Engineer for review and approval

D. Include Manufacturer's seismic certificate.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All identification labeling shall be in compliance with Section 26 05 53 Identification for Electrical Systems.

B. Motor control center floor sills shall be bolted directly to a concrete equipment pad as identified on the Structural Drawings.

C. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed.

D. In general, all conduits entering or leaving a motor control center or switchboard shall be stubbed into the bottom or top horizontal wireway directly below or above the vertical section in which the conductors are to be terminated.

E. Housekeeping pads shall be included for the motor control centers or switchboards as detailed in the Contract Documents.

F. Install the equipment in accordance with the manufacturer's instructions. TVSS installation shall be integrated into the MCC lineup with leads close coupled to busses to limit transient voltages as recommended by the manufacturer.

G. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.

H. Make wiring interconnections between shipping splits.

I. Install bus splice plates and torque connections.

J. Seal all seams, cracks, or openings.

K. Verify that the building environment can be maintained within the service conditions required by the manufacturer of the VFD.

L. Install VFDs as indicated on the Drawings, in accordance with NECA “Standard of Installation.”

M. Install VFDs plumb and level at the height indicated on the Drawings.

N. Install fuses where required.

3.02 FIELD QUALITY CONTROL

A. The CONTRACTOR shall have complete responsibility for field quality control. This includes the following responsibilities:

1. Coordinate MCC installation and testing with other equipment installation and testing per Section 26 01 08.

2. Ensure protection of the equipment from damage during construction. This includes the provision of adequate on site storage facilities prior to installation.

3. Ensure that the area of installation is fully prepared according to the Contract Documents prior to the commencement of the MCC installation.

4. Provide complete and accurate as-built schematic drawings.

B. Site Tests, Inspection

1. In accordance with Section 26 01 08.

3.03 CLEANING

A. After testing is complete, the CONTRACTOR shall inspect and clean the MCC equipment and remove any material introduced during the testing and/ or left from the initial installation. Remove all rubbish and debris from inside and around the control center. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

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SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. This Section includes the requirements for wiring devices such as receptacles, toggle switches and devices plates.

1.02 REFERENCES

A. The following is a list of Standards which may be references in the Section.

1. National Electrical Contractors Association (NECA): National Electrical Installation Standards (NEIS).

2. National Electrical Manufacturers Association (NEMA).

a. WD1 – General Requirements for Wiring Devices.

b. WD6 – Wiring Device Dimensional Requirements.

3. National Fire Protection Association (NFPA): 70.

4. Underwriters Laboratories, Inc. (UL): 1070.

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each

product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General Purpose Receptacles (262726.R01).

1. Shall be heavy duty specification grade, two-pole, three wire grounding type with screw type terminals suitable for number 10 American Wire Gauge (AWG).

2. Shall be NEMA 5-20R, rated for 20 amperes, 125 volt configuration.

3. Provide duplex or single receptacles as shown on the Drawings.

4. Shall be gray in color unless fed from an emergency circuit and in that case the receptacle shall be red in color.

5. Provide Hubbell BR20 Commercial Specification Grade receptacles, or approved equal.

B. Ground Fault Circuit Interrupter Receptacles (262726.R10).

1. Shall be heavy duty hospital grade, two-pole, three wire grounding type with screw type terminals suitable for number 10 American Wire Gauge (AWG).

2. Shall be NEMA 5-20R, rated for 20 amperes, 125 volt configuration.

3. Provide duplex or single receptacles as shown on the Drawings.

4. Shall be gray in color unless fed from an emergency circuit and in that case the receptacle shall be red in color.

5. Provide Hubbell GFR8300SGGY, Hubbell GFR8300SGR for gray receptacles, or approved equal. Red receptacles shall be sample model number except for color designation.

C. General Purpose Toggle Switches (262726.S01).

1. Shall be heavy duty specification grade with grounding screw, 20 amperes, 120-277 volt rated with screw type terminals suitable for number 10 American Wire Gauge (AWG).

2. Single or double throw, single pole, three-way or four-way as shown on the Drawings.

3. Shall be gray in color.

4. Provide Hubbell CSB120 Specification Grade Commercial Series, or approved equal.

D. Wall Mount, Line Voltage, Cooling Thermostat (262726.T10).

1. Provide a wall mounted, line voltage, cooling thermostat as shown on the Drawings.

2. Shall be single pole, rated for 120 volt and the load served with a range of 50 – 90 degrees F.

E. Stainless Steel Device Plates (262726.P01).

1. Install stainless steel device plates at all indoor locations unless called out otherwise on the drawings.

2. Provide Hubbell smooth metal 302/304 super stainless steel, or approved equal.

F. Weatherproof Receptacle Device Plates (262726.P11).

1. Weatherproof receptacle device plates shall be provided as shown on the drawings and in all locations that may be subjected to damp or wet conditions.

2. Weatherproof receptacle device plates shall be in-use type weatherproof receptacle device plates that allow for weatherproof protection even when a cord is plugged into the device.

3. Weatherproof receptacle device plates shall be metallic.

4. Weatherproof receptacle device plates shall be gasketed.

5. Weatherproof receptacle device plates shall be lockable.

6. Weatherproof receptacle device plates shall be UL Listed.

7. The device plate shall be PVC-coated and of a similar design when installed on PVC-coated boxes.

8. Provide Red Dot model CKMUV, or approved equal.

G. Weatherproof Switch Device Plates (262726.P20).

1. Provide a die cast vertical oriented weatherproof switch device plate that allow for an up/down action on a standard toggle switch installation.

2. The device plate shall allow for switching without lifting a device cover.

3. The device plate shall be PVC-coated and of a similar design when installed on PVC-coated boxes.

4. Provide Red Dot CCT type device plates, or approved equal.

H. Device Plate Identification Label (262726.D01).

1. Label all device plates with a vinyl, super adhesive label rated for outdoor use and that is white, 0.375 inches high with 0.25 inch black characters.

2. Provide Brothers product, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems

2. Devices shall be bonded to their enclosure and the equipment grounding conductor with a separate grounding conductor attached to the device which will allow the device to be detached from the enclosure without disconnecting the equipment grounding conductor from the enclosure.

3. The use of the mounting yoke as the only method for bonding is unacceptable.

4. Devices that are not installed at the end of the line (circuit) shall be pig-tailed out and the pig-tails shall be connected to the line and load conductors.

5. After the pigtailed conductors are terminated on the device and before it is installed in the enclosure the exposed energized parts shall be wrapped with electrical insulating tape with a minimum of three wraps.

6. As the device is installed in the enclosure, care shall be taken to neatly fold the conductors inside the enclosure so as to not kink, bind or otherwise damage the sheath of the conductors.

7. Terminations on all devices shall be via pressure or compression type connectors. Wrapping conductors around a termination screw and tightening is unacceptable.

8. Mounting heights for receptacles shall be 18 inches to center from finished floor unless called out otherwise on the Drawings or specified at different height to meet minimum code requirements. Where countertops are present, receptacles shall be mounted horizontally and mounted 4 inches to center above the back-splash. The CONTRACTOR is responsible to coordinate with the approved casework submittals. Failure to do so will require the CONTRACTOR to relocate devices at their expense.

9. Mounting height for switches shall be 46 inches to center above finished grade unless called out otherwise on the Drawings or specified at different height to meet minimum code requirements. Where countertops are present, switches shall be mounted 5 inches to center above the back-splash. The CONTRACTOR is responsible to coordinate with the approved casework submittals. Failure to do so will require the CONTRACTOR to relocate devices at their expense.

10. Coordination is the responsibility of the CONTRACTOR. If a conflict exists for the mounting location of devices, the CONTRACTOR shall bring it to the ENGINEER's attention during the rough-in phase and the ENGINEER shall provide direction. Failure to coordinate conflicts during the rough-in phase will result in relocation of devices at the CONTRACTOR's expense.

11. All receptacles fed from emergency panels shall be red in color.

12. Devices shall be installed level and plumb. Devices shall be brought out plumb with the wall surface via UL listed spacers approved for this purpose if necessary.

13. Devices shall be tested for voltage, polarity, ground integrity and in the case of GFCI receptacles, that they operate as intended.

14. The position of devices, as shown on the Drawings, are general locations only unless dimensioned. The CONTRACTOR is responsible to coordinate with various trades to ensure no conflict exists.

END OF SECTION

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SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes the following enclosed low voltage components rated at 600 VAC or less:

1. Heavy duty single throw, fused, safety switch.

2. Manual Transfer Switch (MTS).

1.02 REFERENCES

A. National Fire and Protection Association (NFPA)

1. 70 - National Electrical Code (NEC)

B. National Electrical Manufacturers Association (NEMA).

1. B 3-2001 - Molded Case Circuit Breakers and Their Application.

2. AB 4-2001 - Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.

3. KS 1-2001 - Enclosed and Miscellaneous distribution Equipment Switches (600 Volts Maximum).

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each

product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

E. Shop Drawings

1. Back panel and enclosure layouts including interior and exterior front and side exterior view details showing maximum overall dimensions.

2. For enclosure weighing 150 pounds and over, provide physical properties, handling and mounting data including total weight, lifting instructions, height, and floor space required. Mounting requirements for seismic zone 4.

3. All drawings shall list the equipment number.

4. Component designations, shall match those shown on the Drawings.

F. Quality Assurance/Control Submittals

1. Manufacturer's Instructions

a. List special requirements or restrictions of the motor/load combination.

b. Submit copy of the manufacturer's operating and maintenance manuals and, installation instructions.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements

1. Products shall be UL listed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection

1. Products shall be stored and installed in a dry environment maintained at 65 degrees F or above.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Heavy Duty Fused Safety Switch (262816.S01).

1. Heavy duty fused safety switches shall be provided as shown on the Drawings.

2. Heavy duty fused safety switches shall be rated for the load served and shall switch all the phase conductors.

3. Heavy duty fused safety switches shall include separate, unswitched, neutral and ground buses where applicable.

4. Heavy duty fused safety switches shall be fused type and provided with appropriate fuses for the application and AIC rating.

5. Heavy duty fused safety switch enclosures shall be painted steel, NEMA 3R, surface mount for outdoor installations and NEMA 12 surface mount for indoor installations.

6. Heavy duty fused safety switch ground bus shall be large enough to accommodate terminations for all grounding conductors.

7. Switch shall accept Type H or Type L fuses.

8. Provide fuses with rating as indicated on the Drawings for all safety switches.

9. Provide Eaton, or approved equal.

B. Heavy Duty Non-Fused Safety Switch (262816.S05).

1. Heavy duty safety switches shall be provided as shown on the Drawings.

2. Heavy duty safety switches shall be rated for the load served and shall switch all the phase conductors.

3. Heavy duty safety switches shall include separate, unswitched, neutral and ground buses where applicable.

4. Heavy duty safety switch enclosures shall 316 Stainless Steel, NEMA 4X, surface mount for outdoor installations and NEMA 12 surface mount for indoor installations.

5. Heavy duty safety switch ground bus shall be large enough to accommodate terminations for all grounding conductors.

6. Provide Eaton, or approved equal.

C. Enclosed Circuit Breaker (262816.B01).

1. Enclosed circuit breakers shall be provided as shown on the Drawings.

2. Enclosed circuit breakers shall be rated as shown on the Drawings.

3. Enclosed circuit breakers shall be UL listed as “Suitable for use as Service Entrance Equipment”, where required.

4. Enclosed circuit breaker enclosures shall be 316 Stainless Steel, NEMA 4X, outdoor, surface mount for outdoor installations and NEMA 12 surface mount for indoor installations.

5. Enclosed circuit breakers breaker shall be molded case thermal magnetic.

6. Enclosed circuit breakers breaker terminals shall be rated for use with 75° C. wire.

7. Enclosed circuit breakers breaker handle shall be capable of being locked out in the OFF position.

8. Enclosed circuit breakers breaker shall indicate on/ tripped/ off status according to the position of the operating handle.

9. Enclosed circuit breakers grounded conductor connection shall be copper.

10. Provide Eaton Cutler Hammer, or approved equal.

D. Manual Transfer Switch (262816.M01).

1. General. The non-automatic transfer switch shall transfer from the normal service to an alternate service. The transfer shall not take place automatically but shall be initiated manually by operating personnel. Transfer back to the normal power supply shall also be initiated manually. The switch shall be UL listed and shall bear the UL label.

2. Construction.

a. The non-automatic transfer switch shall be of the mechanically held double throw type and connected to the transfer mechanism by a simple over-center linkage. All main power contacts and auxiliary contacts shall be mechanically attached to a common shaft, shall be double-break silver alloy with wiping action, and shall be protected by arcing contacts. Arcing contacts shall close before and open after the main contacts and shall be readily replaceable. Contact design and arrangement shall permit repeated making and breaking of full-load current, in a combination of motor and other loads, without damage to the main contacts. Provide a main transfer mechanism utilizing rugged metal parts throughout. Molded circuit breaker type designs are not acceptable.

b. The enclosure shall be NEMA 12 construction with hinged doors on the front for access to the interior controls. Secure doors by a locking type latch. Provide two keys for the lock.

c. Cable connections shall be accessible from the front without removing internal components.

d. Safety Requirements.

1) Arrange the electrical supply to each control panel to be disconnected by a single switch or circuit breaker, except for necessary foreign circuits. Cover any live parts within the control panel fed from foreign control or signal circuits or arrange for them to be disconnected by one of the following methods:

2) Door-operated enclosed disconnect switches; or

3) Clearly identified enclosed manually operated disconnect switches, which may be located inside the control panel door, provided the operating handles are isolated or barriered from all open live parts.

4) Arrange the controls so that manipulation of control switches, adjustments to timing relays, or replacement of fuses can be done without exposure to live parts.

e. The transfer switch shall have the following features:

1) Continuous rating with full neutral bus. Current rating shall be as shown on the Drawings.

2) Adequate line and load lugs for terminating the power conductors shown on the Drawings.

3) A terminal strip with terminals for terminating all external control circuits. Number all terminals using the wire number for the wire terminated.

4) Cable wiring with cable ties, secured in place and guarded where subject to mechanical injury.

5) Permanent identification of each wire at each point of connection using numbered wiring sleeves. Provide electrically common wires with the same number. Uniquely number electrically different wires.

3. UL Label. The transfer switch shall have a UL label on the unit when it arrives at the site. Absence of the UL label shall be sufficient cause for the unit to be rejected. Provide all the specified features, options, and accessories. If the manufacturer's standard UL unit does not have the specified features, options, or accessories, then provide alternative features, options, or accessories to accomplish the same purpose in a manner similar to that specified, while still providing a unit with a UL label.

4. Current Ratings. The transfer switch shall have continuous ampere rating as shown on the Drawings and a short circuit withstand rating for 3 cycles at 480 volts.

5. Finish. Shall be manufacturer's standard not less than 3 mils thick. Color shall be light gray ANSI 61 per Z55.1.

6. Factory Tests. Assemble, wire and test the automatic transfer switch at the factory. Conduct tests to assure that every component functions properly. Submit prototype test reports on bus bracing for the Engineer's review.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

B. Install switches and circuit breakers as indicated on the Drawings.

C. Install equipment level and plumb.

D. Provide nameplates as indicated on the Drawings.

1. Manual transfer switch positions shall be clearly labeled Normal Power, Off & Emergency Power respectively.

3.02 ADJUSTING

A. Adjustable features such as the trip setting for a circuit breaker shall be adjusted pursuant to the manufacturer’s instructions.

END OF SECTION

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SECTION 26 32 00

PACKAGED DIESEL GENERATOR ASSEMBLIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. Requirements for a complete factory assembled generator set with digital electronic generator controls, and digital voltage regulator.
2. The generator and transfer switch shall be of the same manufacturer.
3. Requirements for an outdoor weather-protective enclosure.
4. Requirements for a sub-base fuel tank.

1.02 REFERENCES

A. The following is a list of Codes and Standards that the packaged diesel generator shall conform to. The generator set shall include necessary features to meet the requirements of these standards.

1. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
2. NFPA 70 – National Electrical Code
3. NFPA 99 – Essential Electrical Systems for Health Care Facilities, if applicable to this project.
4. NFPA 110 – Emergency and Standby Power Systems, if applicable to this project.
5. NEMA MG1. Alternator shall comply with the requirements of the current edition of this Standard as they apply to AC alternators.
6. UL 142 – Sub-base Tanks.
7. UL 1236 – Battery Chargers.
8. UL 2200 – The generator set shall be list to UL2200.

B. The generator control system shall comply with the following Codes and Standards.

1. EN 50082-2, Electromagnetic Compatibility, Generic Immunity Requirements, Part 2.
2. EN 55011, Limits and Methods of Measurement of Radio Interference Characteristics.
3. FCC Part 15, Subpart B.
4. IEC 8528 Part 4. Control Systems for Generator Sets.
5. IEC Std. 801.2, 801.3 and 801.5 for susceptibility, conducted and radiated electromagnetic emissions.

6. UL 508. The entire control system of the generator set shall be UL 508 listed and labeled.

C. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying assurance in design/development, production, installation and service in accordance with ISO 9001.

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

3. Provide a complete bill of materials. Any differences between products specified and proposed shall be clearly identified.

4. Manufacturer's product literature, model specifications and performance data sufficient to verify compliance with items specified in 1.02 References of this Section.

5. Complete model number and trip characteristics for the main circuit breaker to be provided.

6. Warranty information complying with the requirements of this Section.

7. Seismic certification for area installed provided by the manufacturer.

8. Seismic calculations for the concrete slab and anchor bolts required. Calculations shall be wet stamped by a Professional Engineer licensed in the State of Oregon.

9. Project specific power and control schematic. The schematic shall clearly identify all field wiring termination points using the same identification shown in the Contract Documents.

10. The generator, fuel tank and battery charger shall, at a minimum have the following I/O points identified on the schematic.

    a. Generator H-O-A in hand.

    b. Generator H-O-A in auto.

    c. Generator running.

    d. Generator warning.

    e. Generator failed.

    f. Generator low fuel.

    g. Battery charger failed.

11. Submittal shall include a line by line compliance statement based on this specification.

12. Manufacturer's document of EPA certification for proposed model generator.

13. Outline drawing showing overall dimensions of generator, tank, enclosure and accessories.

1.04 QUALITY ASSURANCE

A. Qualifications.

1. The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

2. The generator shall be of the same manufacturer as the transfer switch to provide a single source of warranty responsibility for all the products provided.

3. Generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation and service in accordance with ISO 9001.

B. Factory Testing.

1. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be shipped with the generator set.

2. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include; run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup and function of safety shutdowns.

3. Factory testing may be witnessed by the OWNER and/or ENGINEER. Costs for travel expenses will be the responsibility of the OWNER and/or ENGINEER. Manufacturer is responsible to provide a minimum of two weeks notice for factory testing.

1.05 WARRANTY

A. Generator set, fuels tank, enclosure and accessories specified within this Section shall be warranted for a minimum period of 5 years from the date of substantial completion against all defects in materials and workmanship. The warranty shall be comprehensive including all parts, labor and travel.

1.06 SELECTIVE COORDINATION

A. The manufacturer of the generator and overcurrent protection device has been designed to comply with the Selective Coordination requirements of the current edition Oregon Specialty Code. Alternate manufacturers shall be considered only under the following conditions:

1. The Contractor shall provide a design of the entire NEC article 701 Legally Required Standby System distribution system to demonstrate compliance with the Selective Coordination Requirements of the current edition of the Oregon Electrical Specialty Code.

2. The Contractor shall provide scaled floorplans demonstrating that the size of the alternate electrical equipment does not exceed the space requirements of the basis of design.

3. The Contractor shall provide a written document stating that the alternate design complies with the Selective Coordination requirements of the current edition of the Oregon Specialty Code. The document shall be signed and stamped by a licensed Professional Electrical Engineer or Supervising Electrician in the State of Oregon.

4. Acceptance of the alternative shall require written approval by the Engineer.

PART 2 - PRODUCTS

2.01 GENERATOR SET (263200.G01).

A. Manufacturer

1. Basis of design shall be Cummins or approved equal.

B. Ratings.

1. The generator set shall operate at a voltage as shown on the Drawings.

2. The generator set shall be rated as shown on the Drawings. Standby rating, based on site conditions of an altitude of 500 feet above sea level and ambient temperatures up to 104 degrees F.

C. Performance.

1. Voltage regulation shall be plus or minus 0.5 % for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 %.

2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with steady state no load to steady state rated load shall not exceed plus or minus 0.5%.

3. The diesel engine generator set shall accept a single step load of 100 % nameplate kW and power factor, less applicable de-rating factors, with the engine generator set at operating temperature.

4. The generator set shall be capable of recovering to a minimum of 90 % of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 25 %.

5. The alternator shall produce a clean AC voltage waveform, with no more than 5 % total harmonic distortion at full linear load when measured from line to neutral, and no more than 3 % in any single harmonic and no third order harmonics or their multiples. Telephone influence factor shall be less than 40.

6. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating and shall meet all applicable exhaust emission requirements at the time of commissioning.

D. Construction.

1. The engine generator set shall be mounted on a heavy duty steel base to maintain alignment between components. Provide vibration isolators between the engine generator assembly and the structural base. The base shall incorporate a battery tray with hold down clamps within the rails.

2.02 ENGINE AND ENGINE EQUIPMENT

A. The engine shall be diesel, 4 cycle, radiator and liquid cooled, producing 1.5 HP per kW to operate at 1800 rpm for full electrical output rating. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories.

B. An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of the engine coolant temperature to provide fast stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed and accelerating to rated speed.

C. Skid mounted radiator and cooling system rated for the full load operation in 122 degrees F ambient as measured at the alternator air inlet. Radiator shall be prototype tested to verify cooling performance of the engine, radiator and fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange if generator is to be installed indoors. The equipment manufacturer shall fill the cooling system with a 50/50 ethylene glycol / water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.

D. Electric starter(s) capable of three complete cranking cycles without overheating.

E. Provide with full flow lubrication oil filters with replaceable spin on canister elements.

F. An engine driven, mechanical, positive displacement fuel pump. Provide fuel filter with replaceable spin on canister element. Fuel cooler if required for operation due to the design of the engine and the installation.

G. Provide replaceable dry element air cleaner with restriction indicator.

H. Engine battery charging alternator, 40 ampere minimum and solid state voltage regulator.

I. Flexible supply and return fuel lines.

2.03 AC ALTERNATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL 1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees C.

B. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of providing sufficient excitation for the alternator to supply approximately 300 % of rated current for up to 10 seconds.

2.04 GENERATOR SET CONTROL

A. The generator set shall be provided with a microprocessor based control system that is designed to provide automatic starting, monitoring, protection and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set and remote monitoring and control as described in the specification.

B. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all the components in the system under the vibration conditions encountered. All switches, lamps and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control, with the door open, that operate in excess of 50 volts.

C. The generator control enclosure which contains all operator interface switches, lamps, emergency stop switch and accessories listed below, shall be mounted no more that seventy-five (75) inches to the top, above finished floor after the generator set has been

installed on a belly tank, isolation springs or other devices specified herein and/or shown on the Drawings.

D. The generator set controller shall be capable of communicating via Ethernet/IP. The following alarms shall be monitored via Ethernet/IP by the SCADA System:

1. Generator H-O-A in hand.
2. Generator H-O-A in auto.
3. Generator running.
4. Generator warning.
5. Generator failed.
6. Generator low fuel.
7. Battery charger failed.

E. Requirements for control switches are listed below.

1. Mode select switch. The mode select switch shall initiate the following control modes. When in the run or manual position the generator set shall start and accelerate to rated speed and voltage as directed by the operator. A separate pushbutton to initiate starting is acceptable. In the off position the generator set shall immediately stop bypassing all time delays. In the auto position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
2. Emergency stop switch. Switch shall be red mushroom-head pushbutton. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.
3. Reset switch. The reset switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
4. Panel lamp switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed or after the switch is depressed a second time.
5. Voltage and frequency adjustment. The generator set control shall include digital raise / lower switches for adjustment of voltage and frequency.

F. Generator Set AC Output Metering.

1. The generator set shall be provided with a metering set including the following features and functions.
    a. Digital metering set, 1 % accuracy to indicate generator RMS voltage and current, frequency and total load on the generator set.
    b. Generator set alarm and status display.

G. Generator Set Alarm Status Display.

1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high intensity LED type. The lamp condition shall be clearly

apparent under bright room lighting conditions. At a minimum, the control shall have separate indication lamps to indicate the following.

a. Not in Auto.
b. Shutdown.
c. Warning.
d. Remote Start.
e. Auto mode.
f. Manual run.

2. The generator set control shall indicate the existence of warning and shutdown conditions on the generator set control panel for all the following conditions.

a. Low oil pressure (warning and shutdown).
b. High coolant temperature (warning and shutdown).
c. Over current (warning and shutdown).
d. Oil pressure sender failure (warning).
e. Low coolant temperature (warning).
f. Low and high battery voltage (warning).
g. Weak battery (warning).
h. Low fuel level (warning).
i. Engine temperature sender failure (warning).
j. Low coolant level (shutdown).
k. Fail to crank (shutdown).
l. Fail to start/over-crank (shutdown).
m. Over-speed (shutdown).
n. Low and high AC voltage (shutdown).
o. Over and under frequency (shutdown).
p. Field overload (shutdown).
q. Loss of sensing voltage (shutdown).
r. Emergency stop (shutdown).

3. The control system shall incorporate data logging of alarm conditions.

4. Provisions shall be made for indication of customer specified alarm conditions as identified in 1.3 Submittals in this specification, but in no case shall there be less than a minimum of four (4) customer specified alarm or shutdown conditions.

H. Engine Status Monitoring.

1. The following information shall be available from the alphanumeric display panel on the generator set control.

a. Engine oil pressure.
b. Engine coolant temperature.
c. Engine speed (rpm).
d. Number of hours of operation.

e. Number of start attempts.

f. Battery voltage.

I. Engine Control Functions.

1. The control system shall include a cycle cranking system which allows for user selected crank time, rest time and number of cycles. Initial settings shall be for three cranking periods of fifteen seconds each with fifteen second rest period between cranking periods.

2. The control system shall include the engine governor control which functions to provide steady state frequency regulation as noted elsewhere in this specification.

3. The control system shall include sender failure monitoring logic which is capable of discriminating between failed sender or wiring components and an actual failure condition.

4. The control system shall include time delay start (adjustable from 0 to 300 seconds) and time delay stop (adjustable from 0 to 600 seconds) functions.

J. Alternator Control Functions.

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from mis-operation due to load induced voltage waveform distortion and provide pulse width modulated output to the alternator exciter. The voltage regulation system shall control buildup of AC generator voltage to provide linear rise and limit overshoot. The system shall include a torque matching characteristic which shall reduce output voltage in proportion to frequency below adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll off frequency and rate and be capable of being curve matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping and frequency roll off. Adjustments shall be made via digital raise/lower switches with an alphanumeric LED readout to indicate setting level.

2. A microprocessor based protection device shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load exceeds 110 % of the rated current of the generator set for more than sixty seconds. The device shall shutdown and lock out the generator set when output current approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance with the requirements of NFPA 70 (NEC) Article 445.

3. The control shall provide alternator protection from the following conditions.

a. High or low voltage.

b. Over or under frequency.

c. Over current warning or shutdown.

d. Loss of voltage sensing.

e. Field overload shutdown.

4. A microprocessor based AC over / under voltage monitoring system that responds only to true RMSD voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110 % of the operator set point voltage level for more than ten seconds or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85 % for more than ten seconds.

2.05 OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET.

A. The generator set shall be provided with an inherent alternator protection relay. The use of a molded case generator output circuit breaker shall not be acceptable.

1. The relay shall provide overload protection of the generator and generator feeder conductors, per the NEC.

2. The relay shall provide short circuit and ground fault protection.

3. The relay trip curve shall be adjustable to achieve selective coordination.

4. The relay shall selectively coordinate per the NEC and the Oregon Electrical Specialty Code.

5. The generator shall be provided with a disconnect capable of being locked in the open position. This disconnecting means shall not consist of a circuit breaker. The disconnecting means shall comply with the NEC and the Oregon Electrical Specialty Code.

6. The alternator protection shall be Cummins Amp Sentry.

B. Outdoor Weather Protective and Sound Attenuation Enclosure.

1. The generator set shall be provided with an outdoor enclosure (housing) with the entire package listed under UL 2200. Housing shall provide ample airflow for generator set operation at rated load in an ambient temperature of 100 degrees F. The housing shall have lockable hinged access doors as required to maintain easy access for all operating and service functions. Enclosure roof shall be cambered to prevent rainwater accumulation. Openings shall be screened to limit access of rodents into the enclosure.

2. The outdoor weather protective enclosure shall be made of steel.

3. The enclosure shall be insulated with non-hydroscopic materials and reduce the sound level of the generator set while operating at full rated load to a maximum of 75 dBA as measured at seven meters from the generator set in a free field environment.

4. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two step electro-coating paint process. Listed below is the minimum level of performance for the painting process.

a. Primer thickness, 0.5 – 2.0 mils. Top coat thickness, 0.8 -1.2 mils.

b. Gloss, per ASTM D523-89, 80 % plus or minus 5 %. Gloss retention after one year shall exceed 50 %.

c. Cross hatch adhesion, per ASTM D3359-93, 4B-5B.

d. Impact resistance, per ASTM D2794-93, 120-160 inch pounds.

e. Salt spray, per ASTM B1117-90, 1000+ hours.

f. Humidity, per ASTM D2247-92, 1000+ hours.

g. Water soak, per ASTM D2247-92, 1000+ hours.

5. All external enclosure hardware shall be corrosion resistant and hinges shall be stainless steel.

6. A factory mounted exhaust silencer shall be mounted inside the enclosure. The exhaust shall exit the enclosure though a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.

7. The enclosure shall include a flexible oil drain line that extends to the exterior of the enclosure. The enclosure shall include an external radiator fill provision.

C. The generator set shall be provided with a mounted main line circuit breaker sized to carry the rated output current of the generator set and as shown on the Drawings, whichever is greater.

D. Provide a dual wall sub-base fuel storage tank sized to allow for full load operation of the generator set for twenty-four (24) hours at full load. The tank shall be constructed of corrosion resistant steel and shall be UL listed. The equipment, as installed by the CONTRACTOR shall meet all local and regional requirements for the application. The tank shall include all the features listed below.

1. Emergency tank and basin vents, mechanical level gauge and basin drain.

2. Fuel supply and return lines connected to generator set with flexible lines as recommended by the engine manufacturer and in compliance with UL 2200 and NFPA 37 requirements.

3. Leak detection provision and high and low fuel level float switches wired to the generator set control for local and remote alarm indication.

E. Provide a fully automatic battery charger, sized as appropriate for the engine and batteries, as recommended by the engine manufacturer. The charger shall be UL labeled for use in emergency applications and shall include all features necessary to meet NFPA 110 requirements. The charger shall be provided with remote indication of battery charger fail alarm.

F. Thermostatically controlled UL 499 listed coolant heater, sized as recommended by the engine manufacturer to warm the engine to a minimum of 104 degrees F in an ambient temperature of 40 degrees F and in compliance with NFPA 110. Voltage shall be as identified in the Drawings. Coolant heater shall have provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set.

G. Provide engine starting batteries. Starting batteries shall be lead-acid, 12 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of three complete fifteen second cranking cycles at 40 degrees F ambient temperature when fully charged.

H. Provide a thermostatically controlled anti-condensation winding heater on the alternator, sized as recommended by the engine manufacturer. The heater shall be provided with a cord and plug end and a minimum of six feet in length which can be plugged into a receptacle provided by the CONTRACTOR.

2.06 SEISMIC BRACING

A. Provide seismic bracing for the generator set required by the International Building Code and Oregon Structural Specialty Code.

B. The design of the seismic anchoring and bracing system shall be by a licensed Structural Engineer in the State of Oregon. The CONTRACTOR shall arrange and pay for the services of the licensed Engineer.

C. Wet stamped and signed calculations and drawing of the seismic anchoring and bracing system shall be submitted to the Engineer for review and approval

D. Include Manufacturer's seismic certificate.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

2. Equipment shall be installed by the CONTRACTOR in accordance with the final approved submittals, manufacturer’s instructions and Contract Documents.

3. Installation of equipment shall include furnishing and installing all interconnecting conduits and wiring between all equipment provided for the on-site power system.

4. Equipment shall be installed be permanently fastened to the concrete pad in accordance with the manufacturer’s instructions which are specified to meet the seismic requirements for the environment and location installed.

B. Field Quality Control.

1. The local authority having jurisdiction shall approve the installation of the generator set and transfer switch before they are energized.

C. Start-up and Testing

1. An authorized employee of the manufacturer’s service division shall perform the start-up and testing services.

2. The CONTRACTOR shall notify the ENGINEER a minimum of two weeks in advance of the start-up and testing schedule to allow for witnessing of the tests.

3. Provide a signed certificate stating the installation meets or exceed the manufacturer’s installation standards and instructions.

4. Start-up shall include a “cold start” test.

5. Start-up shall verify all local and remote warnings, shutdowns and alarming events are operating as specified.

6. Perform a power failure test on the entire installed system. The test shall be conducted by opening the power supply from the utility service and observing proper operation of the system for at least thirty minutes.

7. Reference the Start-up and Testing specification Section in the Contract Documents for a detailed check list for all processes on the project. The Contractor shall go through the check list to verify compliance and that ask the ENGINEER to witness the tests as the CONTRACTOR goes through them a second time.

8. Coordinate start-up and testing with the transfer switch start-up.

9. Startup shall include operating the generator set with a load bank connected and operating at full load for a minimum of four continuous hours.

10. The CONTRACTOR is responsible to provide diesel fuel for the start-up and testing activities. After start-up and testing is completed and accepted and before substantial completion, the CONTRACTOR shall completely fill the diesel fuel tank.

11. Verification that the generator set and associated specified components are operating as specified.

12. Provide a printout of all as-commissioned adjustable set points for future reference.

D. Seismic Anchoring and Bracing

1. The design of the seismic anchoring and bracing system shall be by a licensed Structural Engineer in the State of Oregon. The CONTRACTOR shall arrange and pay for the services of the licensed Engineer.

2. Wet stamped and signed calculations and drawing of the seismic anchoring and bracing system shall be submitted to the Architect and Engineer for review and approval.

E. Demonstration and Training.

1. An authorized employee of the manufacturer's service division shall perform the demonstration and training services. The demonstration and training period shall last a minimum of 4 hours and shall be provided on site.

2. The OWNER reserves the right to video tape the demonstration and training presentation for future in-house use.

3. Provide training handouts for 10 persons.

END OF SECTION

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SECTION 26 51 00

INTERIOR LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. This Section includes the requirements for the interior illumination fixtures and controls.

1.02 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements.

1. All products shall be UL listed for the environment they are installed in.

PART 2 - PRODUCTS

2.01 FIXTURES

A. Fixtures shall be provided as identified on the Luminaire Schedule in the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. All identification labeling shall be in compliance with Section 260553 Electrical and Control Identification.

2. CONTRACTOR shall provide all mounting hardware required to mount luminaires in lay-in or gypsum board ceilings. Verify ceiling types with the ARCHITECT. Luminaires of a given type may be used in more than one type of ceiling.

3. Luminaires shall be supported by #12 AWG hanger wire connected to the luminaire and the building structure.

4. Positively attach all luminaires to the suspended ceiling system. Attachment devices shall have capacity of 100% of the luminaire weight acting in any direction.

5. Verify luminaire locations with the ARCHITECT'S reflected ceiling plan.

6. Adjustable luminaire heads shall be aimed as directed by the ENGINEER.

7. All luminaires shall be cleaned of all dirt, dust, and finger prints prior to close-out.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. This Section includes the requirements for exterior illumination fixtures and control.

1.02 SUBMITTAL

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

1.03 QUALITY ASSURANCE

A. Regulatory requirements.

1. Products provided shall be UL listed for the environment in which they are installed.

PART 2 - PRODUCTS

2.01 FIXTURES

A. Provide fixtures as identified on the Luminaire Schedule on the Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General.

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

2. Fixtures mounted above doors shall be centered unless specifically called out otherwise on the Drawings.

3. Fixtures mounted on the exterior of split face block shall be fed with a conduit entering the back of the fixture routed from the interior of the building. Mounting the fixture on a box is unacceptable.

4. Use stainless steel mounting hardware.

5. Mount at the height shown on the Drawings.

6. Fixtures mounted on the building shall have a photo electric control with a manual toggle switch override unless shown differently on the drawings.

B. Light Poles.

1. Shall be mounted level and plumb.

2. Shall be installed per the detailed Drawing. Provide the rebar, anchor bolts and 3000 PSI concrete for the pole bases.

3. Light fixture heads shall be oriented as shown on the Drawings.

4. Using non-shrink grout, the CONTRACTOR shall grout smooth all exposed areas of the concrete pole base, filling all air pockets and irregularities.

C. Photo Electric Switch.

1. Externally mounted photo electric switches shall be oriented north if at all possible.

2. Shall be oriented away from artificial light sources.

END OF SECTION

SECTION 27 32 00

TELEPHONE AND DATA EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements for telephone, data communication systems.

2. The requirements of Section 26 05 00 – Common Work Results for Electrical shall apply to the work performed under this Section.

1.02 REFERENCES

A. National Fire Protection Agency (NFPA)

1. 70, National Electrical Code (NEC).

B. American National Standards Institute (ANSI)

1. ANSI/J-STD-607-A: Commercial building grounding and bonding requirements for telecommunications current edition.

C. Electronics Industries Association (EIA)

D. Telecommunications Industry Association (TIA)

E. Conduit and installation requirements of telephone utility.

1.03 SYSTEM DESCRIPTIONS

A. CONTRACTOR shall provide new communication services for the following systems:

1. Internet

2. Phone (POTS)

B. CONTRACTOR shall coordinate with the communication service provider the following requirements:

1. Quantity, size, and routing of new communication service conduits

2. Trenching and backfilling

3. Boring beneath roadways

4. Penetrations into existing building

1.04 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the

specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper rright hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Conduit vaults and pulling rope shall be provided as per the Contract Documents and the utility's requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

B. Install conduit, pull lines, phone board, grounding, bonding in accordance with the Contract Documents and the utility's requirements

END OF SECTION

SECTION 31 00 00

EARTHWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Earthwork requirements for sitework, structures, roads and general earthwork, including excavation, fill, backfill, grading, and compaction; import of material; and disposal of surplus and unsuitable materials.

B. Refer to Section 31 23 16.13 for earthwork related to pipeline installation.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 31 10 00 – Site Preparation
3. Section 31 23 16.13 – Trenching
4. Section 31 23 16.26 – Rock Excavation
5. Section 31 23 19 – Dewatering
6. Section 31 50 00 – Excavation Support and Protection
7. Section 32 11 23 – Aggregate Base Course Material

1.03 DEFINITIONS

A. Backfill: Earthwork necessary to add fill between new structures and the excavation up to the sub or finish grade.

B. Borrow Area: Area identified from which to obtain earthwork materials.

C. Cut: Earthwork necessary to remove existing material to lower the existing grade in elevation to sub or finish grade.

D. Embankment: Materials placed to form the subgrade for roadways or site improvements.

E. Excavation: Earthwork necessary to remove existing material for the installation of structures.

F. Fill: Earthwork necessary to add material to bring the existing grade up in elevation to sub or finish grade.

G. Finish Grade: Final surface following placement of surfacing, if any, as indicated.

H. Subgrade: The surface of the earthwork on which pavement, surfacing, base, subbase, or a layer of any other material is placed.

1.04 SUBMITTALS

A. Prepare submittals and submit in accordance with Section 01 33 00.

B. For imported materials, provide certification and source.

C. For excavations 5 feet or deeper: Submit detailed plan of all shoring, bracing, side sloping, or other provisions for worker protection against the hazard of caving ground during excavations in accordance with Section 31 50 00.

1.05 QUALITY ASSURANCE

A. Materials and Compaction Testing.

1. Source testing of materials: Provided and paid for by Contractor.

2. Field testing of compaction: Provided and paid for by Owner.

B. Compaction Testing Standards

1. In-place Density of Compacted Fill Material: Density determined in the field in accordance with ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

2. Maximum Dry Density of Compacted Material: determined in the laboratory in accordance with Method C of ASTM D1557-12e1 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

C. Material Testing Standards:

1. Particle size analysis of soils and aggregates: ASTM D6913 – Standard Test Methods for Particle-Size Distribution of Soils Using Sieve Analysis. ASTM D7928– Standard Test Method for Particle-Size Distribution of Fine-Grained Soils Using the Sedimentation Analysis.

2. Determination of sand equivalent value: ASTM D2419 – Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

3. Liquid limit, plastic limit, and plasticity index: ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

4. The testing for organic matter: ASTM D2974 – Standard Test methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.

D. References in this section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes. Contractor shall be bound by all applicable provisions of ASTM D2487 in the interpretation of soil classifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General fill, backfill, and embankment materials:

1. Selected or processed clean earth, rock, or sand, free from grass, roots, brush, other vegetation, corrosive and hazardous materials, manmade objects, and debris.

2. Materials not defined as unsuitable as indicated below, except some materials listed as unsuitable may be used, if indicated on the Drawings or when acceptable

to the Engineer, when thoroughly mixed with suitable materials to form a stable composite.

3. Obtain suitable materials from one or more of the following:

4. Onsite excavations and designated borrow areas.

5. Processed on-site materials.

6. Onsite soils are not suitable for use as structural fill.

7. Imported from offsite borrow areas and processing plants.

8. If imported materials are required by this Section, or to meet the quantity requirements of the Project, provide the imported materials at no additional expense to Owner, unless a unit price item is included for imported materials in the Bidding Schedule.

9. Large rocky material: When embankment material consists of large rocky material, or hard lumps, such as hardpan or cemented gravel which cannot be broken down readily, distribute such material evenly throughout the embankment. Place sufficient earth or other fine material around the larger material as it is deposited so as to fill the interstices and produce a dense, compact embankment. Do not place rocks larger than 6 inches in diameter within the upper 2 feet of the embankment subgrade.

10. Further condition fill, backfill, and embedment materials as described below or as indicated on the Drawings.

B. Structural Fill

1. 1.5 inch or ¾ inch minus Dense Graded Aggregates as Defined in Section 02630-10 of the Oregon Standard Specifications for Construction

C. Structure Backfill Material

1. Open Graded Aggregate as defined in Section 2630.11 of the Oregon State Standard Specifications for Construction

D. Subgrade Stabilization material

1. Well graded granular material

2. Maximum size of 4 inches

3. Less than 5 percent passing the No. 4 Sieve

4. Free of organic material

E. Reinforcement Geotextile:

1. Permeable, woven

2. Polypropylene, polyester or a combination of both

3. Meeting requirements of Type 2 Woven Riprap Geotextile, as defined in Table 02320-2 of the Oregon State Standard Specification for Construction

4. Approved manufacturers

a. TenCate Mirafi, RS 380i

F. Aggregate Base Course Material: In accordance with Section 32 11 23.

G. Sand:

1. Clean, coarse, natural sand free from organic material, suitable for the purpose intended.

2. Gradation: 90 percent to 100 percent will pass a No. 4 sieve and not more than 5 percent will pass a No. 200 sieve.

2.02 UNSUITABLE MATERIALS

A. Unsuitable materials include the materials listed below:

1. Soils which, when classified under ASTM D2487, fall in the classifications of Pt, OH, CH, MH, or OL, or in a classification that contains Pt, OH, CH, MH, or OL in combination with any other letter designation, such as CH/CL.

2. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use, or are unstable or pump regardless of the degree of compaction.

3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.

4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the average values for existing onsite soils.

5. Topsoil, sludge and sludge-entrained soils.

6. Rocks, stones, and boulders larger than 6-inches in diameter.

7. Onsite soils are not suitable for use as structural fill.

2.03 SOURCE QUALITY CONTROL

A. Materials source testing will be performed by a testing laboratory by a third-party special inspections and testing firm retained by the Owner.

B. Minimum Frequency of sampling:

1. Fill, backfill and embankment material generated from earthwork activities:

2. Two soil samples every 500 cubic yard of material used.

3. Two soil samples whenever the character of the soil changes.

4. One soil sample when directed by the Engineer.

5. Obtain samples that represent the predominate character of the soil that is encountered.

6. Sampling of Imported Material

7. Obtain representative samples of product from supplier.

8. After initial testing demonstrated that the proposed borrow material meets the specified requirements, obtain and test one additional sample for every 500 cubic yard of imported material.

C. Testing:

1. Test all materials used in the Work to confirm they meet the requirements indicated.

2. Prepare moisture-density curves for use in determining the optimum moisture content and in-place density of the compacted backfill.

PART 3 - EXECUTION

3.01 EXCAVATION – GENERAL

A. Excavation includes the removal of all materials of whatever nature encountered, including all obstructions of any nature.

B. Excavation shall conform to the lines and grades indicated on the Drawings.

C. Clear, grub and strip and remove topsoil in construction and borrow areas in accordance with Section 31 10 00.

D. Excavation Stability

1. Slope excavated faces or otherwise support in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and in accordance with Section 31 50 00.

2. Furnish, and place the supports and shoring required to maintain stability of all sides of the excavations.

E. Notify Engineer at least 1 working day in advance of completion of any structure excavation to allow inspection of the exposed subgrade before it is covered with backfill or with any construction materials.

F. Erosion Control:

1. Maintain earthwork surfaces true and smooth and protected from erosion.

2. Construct erosion control measures identified in the Erosion and Sediment Control Plan prior to any clearing or grading activity.

G. Control of Water: Control water entering the excavation as indicated in Section 31 23 19.

H. Existing Underground Utilities:

1. Known existing underground utilities are generally shown on the Drawings in their approximate locations based on information of varying accuracy.

2. Exercise care to avoid damage to all existing utilities whether shown or not.

3. Conduct field explorations to locate all underground utilities in the vicinity of the Earthwork activities in accordance with Section 31 10 00.

4. Alert the Engineer of the presence of existing utilities that are not shown on the Drawings or are in locations different than those shown on the Drawings.

I. Existing Overhead Utilities: There may be existing overhead utilities in the vicinity of the Work which may or may not be shown on the Drawings. Identify existing overhead utilities, if any, and use extreme caution when working in the vicinity of overhead utilities.

3.02 EXCAVATION FOR FILLS AND EMBANKMENTS

A. Benching and Keyways:

1. Where fill is to be placed against existing subgrade or existing grade that is sloped, excavate horizontal benches a minimum of 5 feet wide and located at vertical intervals of not more than 5 feet to provide for placement and compaction of the new fill on horizontal surfaces.

2. Excavate keyway along the base of the existing slope:

3. Extend the keyway at least 3 feet into competent native soil.

4. Width of Keyway: Minimum of 15 feet.

5. Keyway Side Slopes: Inclined at approximately 0.75:1.

6. Keyway Subgrade: Scarify the upper 8-inches of the exposed surface, moisture condition and re-compact.

B. Subgrade Preparation:

1. Subgrade Beneath Embankments:

2. Expose competent native soil within the planned new embankment footprint.

3. Scarify the exposed subgrade to a depth of 12 inches or depth to bedrock, moisture condition as necessary and re-compact.

4. Subgrade Beneath Paved Areas:

a. Excavate to the subgrade soils beneath the bottom of the subbase.

b. Place reinforcement geotextile as shown on drawings.

c. Finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement.

5. Subgrade Beneath Structures:

6. At grade structures

1) Excavate 3 feet of undocumented fill or to basalt rock layer and replace with compacted imported structural fill.

2) Extend imported structural fill horizontally beyond the exterior perimeter of the building and footing a distance equal to the height of the fill or 3 feet whichever is greater.

7. Below grade structures

1) Excavate to basalt rock layer and replace with compacted imported structural fill.

2) Provide a minimum of 2 and a maximum of 12 inches of imported structural fill as leveling course for spread and continuous footing over the basalt rock subgrade.

3) Provide a 6-inch layer of imported structural fill for mat foundation over the basalt rock subgrade.

4) Extend imported structural fill horizontally beyond the exterior perimeter of the building and footing a distance equal to the height of the fill or 3 feet whichever is greater.

3.03 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, protect trees form injury during construction.

B. Do not cut tree roots over 2 inches in diameter without permission of the Engineer.

C. Support trees during excavation by means approve by the Engineer.

3.04 OVER-EXCAVATION NOT ORDERED OR INDICATED

A. Backfill areas over-excavated with the materials indicated for the backfill above the over-excavation or Aggregate Base.

B. Backfill the over-excavation to restore the required subgrade elevation and compact.

C. Any over-excavation carried below the grade indicated on the Drawings will be at no additional cost to Owner.

3.05 OVER-EXCAVATION WHERE ORDERED BY ENGINEER

A. Where ordered by the Engineer, over-excavate beyond the depth of subgrade indicated to the dimensions ordered.

B. Backfill areas over-excavated with the materials indicated for the backfill above the over-excavation or Aggregate Base.

C. Backfill the over-excavation to restore the required subgrade elevation.

D. Over-excavation less than 6 inches below the limits indicated: At no increase in cost to Owner.

E. Over-excavation greater than 6 inches below the limits indicated: Payment will be made under separate unit price bid items for over-excavation if such bid items have been established. Otherwise, payment will be made in accordance with a negotiated price.

F. Measurement and Payment

1. Measurement of quantities for payment of over-excavation: By calculation by Engineer of the volume of materials removed as over-excavation based on the difference between the excavation dimensions before and after the over-excavation work. No compensation will be made for removal of materials beyond the limits of the additional excavation ordered by Engineer or for materials which may come into the excavation from outside the designated limits. No compensation will be made for removal of materials that are outside of the minimum horizontal dimensions indicated.

2. Payment for over-excavation will be made by the cubic yard. The payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in excavating and backfilling the over-excavation completely. Payment shall also include full compensation for

the removal and disposal of the excavated materials, import and installation of backfill materials, control of water in the excavation, excavation support, and all costs associated with interruption of construction operations during the review of the foundations, over-excavation, backfill, and all other operations required for, or as a result of, over-excavation.

3.06 ROCK EXCAVATION

A. Perform rock excavation in accordance with Section 31 23 16.26.

3.07 DISPOSAL OF UNSUITABLE, EXCESS EXCAVATED AND OTHER MATERIALS

A. The Owner has identified a site for disposal of clean excess excavated earth materials located at Quarry Park, 3101 Zelkova Street, Sweet Home, Oregon 97386. The Contractor may use a different disposal site with written authorization from the property owner of the disposal site. Clean materials shall meet the requirements of Section 2.01.A.1.

B. Dispose unsuitable materials at an appropriate site selected by Contractor unless otherwise indicated.

C. Obtain required permits, landowner, and agency approvals for disposal of unsuitable and excess excavated materials and pay costs associated with the removal and disposal of the materials.

3.08 FILL AND EMBANKMENT CONSTRUCTION

A. Scarify foundation soils for fills and embankments bring to optimum moisture content, and re-compact with heavy compaction equipment to obtain compaction indicated.

B. Place and compact fill and embankments in horizontal layers so that when compacted layers to not exceed thickness indicated.

C. Provide keyways or benches where an embankment or fill is to be placed against slopes, hillsides, or fill slopes.

D. Slopes: Construct slopes as indicated except construct no permanent fill or embankment slopes with slope inclinations that exceed 2:1 (horizontal: vertical) unless specifically indicated otherwise

E. Over-construct fills and embankments beyond the horizontal dimensions than indicated. Cut back slope following placement and compaction to expose well compacted fill.

F. Construct the first 3 feet of embankment or fills over pipelines using placement and compaction equipment that do not damage the pipe. Keep heavy construction equipment a minimum distance of the edge of the trench equal to the depth of the trench until at least 3 feet of fill over the pipe has been placed and compacted.

3.09 STRUCTURE BACKFILL

A. Provide Structure Backfill material within 12-inches of all structures to be backfilled unless otherwise indicated.

B. Place a 6-inch layer of structural fill below all structures, unless otherwise indicated.

C. Do not drop backfill upon any structure or pipe.

D. Confirm concrete structures have attained sufficient strength to withstand the backfill loads imposed.

E. Do not place backfill around water retaining structures until structures have been tested and approved for backfill. Fill structures with water during backfill operations.

F. Place backfill after all water has been removed from the excavation and the excavation sidewalls and subgrade soils have dried to a moisture content suitable for compaction.

G. Remove all loose, sloughing, or caving soils and rock materials prior to placement of backfill.

H. Place geotextile fabric as indicated.

I. Promptly after removal, fill voids created by the extraction of sheetpile or shoring indicated in Section 31 50 00.

J. Place backfill and spread evenly in layers so that when compacted layers do not exceed thickness indicated.

K. Thoroughly mix layers as necessary to promote uniformity of material in each layer.

L. Add water to backfill material such that moisture content is below the optimum moisture content and mix with the soil until the proper moisture content is achieved throughout the soil layer.

M. Where backfill material moisture content is too high to permit the specified degree of compaction, dry backfill material until moisture content is satisfactory.

3.10 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS

A. Adjust moisture condition of soils to achieve a water content of 2 percent, plus or minus 0.5 percent, above the optimum moisture content as determined through moisture density testing of the soil.

B. Compact each layer in a uniform and systematic manner.

C. For materials with less than 10 percent passing the No. 4 sieve, compact by means of at least 2 passes from a flat plate vibratory compactor.

D. For materials with 10 percent or more passing the No. 4 sieve, mechanically compact to the indicated percentage of density each layer of backfill materials.

1. Use equipment that is consistently capable of achieving the required degree of compaction.

2. Compact each layer over its entire area while the material is at the required moisture content.

E. For wall backfill placed within 3 feet of the wall use hand-operated tamping equipment, such as jumping jack or vibratory plate compactors.

F. Do not use flooding, ponding, or jetting as a method of compaction.

G. Do not use equipment weighing more than 10,000 lbs closer to structure walls than a horizontal distance equal to the depth of the fill at the time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.

H. Compaction Requirements:

1. Where agency or utility company requirements govern, the highest compaction standards shall apply.

2. Compact finish and subgrades in compliance with the following table:

Location or Use of Fill	Limit/Layer Thickness	Percentage of Maximum Dry Density of Compacted Material per ASTM D1557
Imported Structural Fill General Use	8 in. Layers	92
Backfill within 3 feet of walls	Less than 6 in Layers	90
Upper 2 feet of backfill within 3 feet of walls when sidewalks or pavements are placed above the backfill	Less than 6 in Layers	95
Embankment Fill	12 in. Layers	90(1)
Subgrade beneath embankments or fill areas (upper 8 inches)	Upper 12 in.	92
Subgrade beneath structures	8 in. Layers.	92
Subgrade beneath keyway (upper 8 inches)	Upper 8 in.	95
Finish grade in unimproved or landscape areas	Upper 12 in.	85
(1) If embankment fill is non-moisture-density testable, compaction shall be assessed by proof-rolling per ODOT TM158 or other visual means per the Engineer.		

3.11 FIELD QUALITY CONTROL AND TESTING

A. Field quality control testing for compaction confirmation will be done by a testing laboratory of the Owner's choice at the Owner's expense except as indicated below.

B. If requested by the Owner, remove soil above the level at which the Owner wishes to test. Backfill and re-compact material after testing is completed.

C. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:

1. Remove and replace backfill at proper density.

2. Bring density up to specified level by other means acceptable to Owner.

3. Retesting:

a. Costs for conducting additional tests to confirm and verify that remedial work has brought compaction within specified requirements shall be borne by the Contractor.

b. Conduct compaction tests at twice as frequently specified for the initial confirmation tests.

D. Where soil compaction is specified as a percentage of maximum dry density, determine the maximum dry density at optimum moisture content by laboratory testing in accordance with Method C of ASTM D1557.

E. Where compaction of cohesionless, free draining soil is specified as a percentage of relative density, determine relative density by laboratory testing in accordance with ASTM D1557.

F. Determine In-Place Density of Compacted Fill Material by performing field tests of soil density in accordance with ASTM D6938.

G. Frequency of Compaction Confirmation Testing at intervals not less than as follows:

1. Each lift shall be tested prior to placing a subsequent lift.

3.12 FINISH GRADES

A. Surface: Reasonably smooth and free of grade breaks, irregular surface changes, protrusions and other defects.

B. Restore un-improved areas back to pre-construction grades.

C. Backfill topsoil in all areas where the topsoil was removed as part of the site preparation.

D. Restore drainage swales and water courses to their pre-construction alignments and grades unless otherwise modified by the Work. Grade surface to drain away from structures. Direct drainage to collection points.

E. Provide smooth transitions to existing grades.

F. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur prior to final acceptance.

G. Vertical Tolerance:

1. Subgrade under paved areas: 0.0 feet above and 0.08 feet below.

2. Subgrade under structures: 0.0 feet above and 0.08 feet below.

3. Landscaped areas: 0.1 feet above and 0.1 feet below.

4. Unimproved areas: 0.1 feet above and 0.1 feet below.

END OF SECTION

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SECTION 31 10 00

SITE PREPARATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Site preparation work, as follows:

1. Locating existing facilities.
2. Installing safety and protective barriers.
3. Constructing temporary access roads, work areas and storage areas.
4. Clearing, grubbing, stripping, and other initial work required for earthwork and trenching operations.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 01 72 50– Protection of Existing Facilities

1.03 DEFINITIONS

A. Clearing and Grubbing: Consists of removal of natural obstructions and man-made objects and features including foundations, buildings, fences, lumber, stumps, debris, rubbish, brush, trees, boulders, and other items that interfere with construction operations or are specifically designated for removal.

B. Stripping: Includes the removal and disposal of sod, grass, weeds, roots, and other organic material remaining after clearing has been completed.

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Submit:

1. Materials used and layout of temporary fences
2. Proposed staging and stockpile locations.

PART 2 - PRODUCTS

2.01 TEMPORARY FENCES

A. Type: Heavyweight, high visibility, flat laminar mesh design.

B. Material: High-density polyethylene.

C. Height: 48 inches.

D. Posts: Wood or metal posts at 10-foot spacing. Secure fence to posts with plastic cable ties.

PART 3 - EXECUTION

3.01 LOCATING EXISTING FACILITIES

A. Review the design drawings, maps, and other sources of information and identify existing facilities at the site to determine and mark the approximate locations of underground facilities.

B. Follow rules adopted by the Oregon Utility Notification Center regarding locating and marking existing buried utilities and contact owners of existing underground utilities prior to beginning work in the vicinity of their utilities.

C. Refer to Section 01 72 50. Locate all existing utilities by exploratory excavations after field marking by the utility agencies and prior to any excavations in the affected areas.

3.02 SAFETY AND PROTECTIVE BARRIERS

A. Along Public Roadways:

1. Install appropriate barriers such as temporary fencing, plastic drums, or concrete traffic barriers to protect public from construction areas and to protect workers and existing facilities from danger of passing vehicles.

B. Temporary Fences:

1. Prior to beginning excavation, erect temporary fences along boundaries of the work area indicated on the Drawings.

2. Maintain work activities within the confines of the temporary fences.

3. Remove temporary fences when work in the vicinity is substantially complete.

C. Existing Trees: Erect temporary fences around trees at the drip line that are adjacent to the Work and may be subject to damage unless protected. Maintain work activities outside of protected areas.

D. Provide protective concrete slabs, steel plates or encasements for existing buried facilities that may be damaged by Contractor's equipment and vehicles.

3.03 PRIMARY SITE ACCESS, WORK AND STORAGE AREAS

A. Coordinate with the Owner and Engineer to develop primary access routes, work areas and storage areas.

B. Protect subgrade soils in stripped and graded areas as follows:

1. Place a minimum of 12 inches of crushed rock base material in temporary construction traffic areas.

2. Place a 18-24 inches of crushed rock base material to as necessary to protect subgrade soils in heavily traveled construction traffic areas.

3. Place a minimum of 4 inches of crushed rock base material in pedestrian areas.

C. Clean up areas at the conclusion of the project and return the areas to their original or better condition.

3.04 CLEARING

A. Clear construction areas of objectionable items and material, which, if left in place, would interfere with the proper performance of the work.

B. Remove loose boulders within 10 feet from the tops of cut slopes. Incorporate boulders into landscaping or remove from the site.

C. Dispose of material from clearing operations in an acceptable off-site location.

3.05 STRIPPING

A. Remove the top layer of soil containing sod, grass, weeds, other vegetation, and organic material to a depth of 6 inches from areas that will be affected by construction and site grading operations.

B. Extend stripped areas at least 4 feet beyond the limits of cut and fill areas.

C. Protect soils in stripped areas as described in Section 3.03.

D. Dispose of stripped material in an acceptable off-site location.

3.06 TREE REMOVAL

A. Remove specific trees indicated on the Drawings for removal. Cut tree so they fall into the area being cleared. Cut stumps no higher than 4 inches above the ground surface if the tree is within an area that will otherwise be undisturbed. Remove felled tree from the site.

B. Timber Salvage: Owner may elect to retain felled trees within 7 calendar days. If Owner chooses not to retain felled trees, the ownership of timber shall revert back to the Contractor.

3.07 REMOVAL OF EROSION CONTROL DEVICES

A. Remove erosion control devices when bare soils are sufficiently revegetated to prevent on-site or off-site soil erosion, if authorized by the Engineer.

B. Straw wattles containing plastic netting, including plastic specified as phot-degradable, may not remain on site. Remove entire wattle or remove and dispose of plastic netting and spread straw from wattle across vegetated areas of site.

END OF SECTION

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SECTION 31 23 16.13

TRENCHING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Trench excavation and backfilling for pipe and pipeline appurtenances.

B. Minor structure excavation and backfill associated with pipeline construction.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 12 16 – Work Sequence and Constraints
2. Section 01 33 00 – Submittals
3. Section 01 72 50 – Protection of Existing Facilities
4. Section 03 30 00– Cast-in-Place Concrete
5. Section 03 60 00 –Grout
6. Section 31 10 00 – Site Preparation
7. Section 31 23 16.26– Rock Excavation
8. Section 31 23 19 – Dewatering
9. Section 31 23 23.33– Controlled Low Strength Material
10. Section 31 50 00– Excavation Support and Protection
11. Section 32 01 16– Pavement Restoration
12. Section 32 11 23– Aggregate Base Course Material

1.03 DEFINITIONS

A. Backfill: Earthwork necessary to provide fill between new structures and excavation up to the sub or finish grade.

B. Bedding Zone: The area from the trench subgrade to the bottom of the pipe.

C. Embedment or Pipe Zone: The area from the top of the Bedding Zone to the bottom of the Trench Zone as indicated on the Drawings.

D. Excavation: Earthwork necessary to remove existing material for the installation of structures.

E. Finish Grade: Final surface following placement of surfacing, if any, as indicated.

F. Native Material: Naturally occurring soils excavated from the trench after top soil, if any, has been removed.

G. Open Areas: Areas along the pipeline route that are outside Roadway Shoulders or in open pasture.

H. Pavement Section: The upper portion of the trench within paved areas comprising the base and finished surface materials.

I. Roadway Shoulders: Paved areas and unpaved areas outside the traveled way and extending to the outside edge of any roadside drainage features.

J. Spoils: Unsuitable or excess excavated materials.

K. Subgrade: The surface of the earthwork on which bedding, base materials, pavement, other surfacing materials, or structure bases are placed.

L. Traveled Way: The portion of the roadway where vehicles travel, does not include shoulders.

M. Trench Backfill: Materials used to backfill the trench including bedding zone, pipe zone, and trench zone backfill.

N. Trench Zone: The area from the top of the Pipe Zone to the bottom of the pavement base (subgrade), ground surface or other surface material over the trench excavation.

O. Wet Trench: Trench with water or groundwater present in the trench.

1.04 SUBMITTALS

A. Prepare submittals and submit in accordance with Section 01 33 00.

B. Material Data: Submit the following for each material type imported to the site:

1. Material source.

2. Gradation.

3. Moisture-density curves.

4. Permeability tests (for clay material).

C. All material submittals must be dated to less than 1 year prior to Notice-to-proceed.

D. For excavations 5 feet or deeper, submit detailed plan of all shoring, bracing, side sloping, or other provisions for worker protection, as well as the protection of existing adjacent utilities and structures, against the hazard of caving ground during excavations in accordance with Section 31 50 00.

E. Submit name and qualifications of materials testing lab for Contractor furnished testing.

1.05 QUALITY ASSURANCE

A. Materials and compaction testing

1. Source Testing of Materials: Provided and paid for by Contractor

2. Field Testing of Compaction: Provided and paid for by Owner.

3. For contractor provided testing, provide testing performed by a qualified testing laboratory approved by the Owner. Submit testing laboratory qualifications for approval.

B. Compaction Testing:

1. In-place Density Testing of Compacted Fill Material: ASTM D6938 – Test Methods for Density of Soil and Soil Aggregate by Nuclear Methods (shallow depth).

2. Maximum Dry Density:

a. Cohesive soils: ASTM D1557

b. Cohesionless, free draining soils: ASTM D1557

C. Materials Testing Standards:

1. Particle size analysis of soils and aggregates: ASTM D422 – Method for Particle-Size Analysis of Soils.

2. Determination of sand equivalent value: ASTM D2419 – Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

3. Liquid limit, plastic limit, and plasticity index: ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

4. Testing for organic matter: ASTM D2974 – Standard Test methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.

5. Testing for percentage of fractured particles: ASTM D5821.

6. References in this section to soil classification types and standards: Meanings and definitions indicated in ASTM D2487 – Classification of Soils for Engineering Purposes.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General:

1. Obtain trench backfill materials from one or more of the following:

a. Imported from off-site borrow areas,

b. Processing plants.

2. Provide materials as indicated or as may be necessary to complete the Work at no additional cost to the Owner, unless a unit price item is included for trench backfill materials in the bidding schedule.

3. Provide materials as indicated in the Schedule in PART 3.

4. Soils unsuitable for use as trench backfill materials:

a. Soils classified under ASTM D2487 categories Pt, OH, CH, MH, or OL; or soils that contain classifications Pt, OH, CH, MH, or OL in combination with any other soil classification, such as CH/CL.

b. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use, are highly expansive, or are unstable or "pump", regardless of the degree of compaction.

c. Soils that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable Regulations.

d. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing on-site soils.

e. Topsoil, except as allowed below.

f. Soils containing rocks, stones, or boulders larger than specified.

g. Soils that contain more than 5 percent organic matter when tested in accordance with ASTM D2974.

B. Structural Fill

1. 3/4 inch minus Dense Graded Aggregates as Defined in Section 02630-10 of the Oregon Standard Specifications for Construction

C. Subgrade Stabilization material

1. Well graded granular material

2. Maximum size of 4 inches

3. Less than 5 percent passing the No. 4 Sieve

4. Free of organic material

D. Controlled Low Strength Material (CLSM): As specified in Section 31 23 23.33.

E. Aggregate Base: As specified in Section 32 11 23.

F. Reinforcement Geotextile:

1. Permeable, woven

2. Polypropylene, polyester or a combination of both

3. Meeting requirements of Type 2 Woven Riprap Geotextile, as defined in Table 02320-2 of the Oregon State Standard Specification for Construction

4. Approved manufacturers

a. TenCate Mirafi, RS 380i

G. Structure Backfill Material:

1. Open Graded Aggregate as defined in Section 2630.11 of the Oregon State Standard Specifications for Construction

H. Concrete: In accordance with Section 03 30 00.

2.02 SOURCE QUALITY CONTROL

A. Perform source quality control testing by approved testing laboratory and submit results to Owner.

B. Frequency of Sampling of Imported Material: After initial testing demonstrates that the proposed borrow material meets the specified requirements, obtain and submit one additional sample for every 500 cubic yards of imported material.

PART 3 - EXECUTION

3.01 EXISTING UTILITY LOCATIONS

A. Perform subsurface investigations to locate existing underground utilities in accordance with Section 01 72 50.

3.02 REMOVAL AND REPLACEMENT OF PAVEMENT

A. In paved areas, remove and replace pavement as follows unless otherwise indicated:

1. Saw cut existing pavement along each side of the trench.

2. Remove and dispose of the pavement lying within the limits of the saw cuts and from adjoining areas damaged by the cutting, removal, excavation and backfilling operations.

3. During subsequent trench excavation and backfill activities, minimize disturbance of the adjoining pavement.

4. Restore pavement surfaces in accordance with Section 32 01 16.

5. Refer to drawings and Section 01 12 16 for additional pavement removal and replacement requirements.

3.03 TRENCH EXCAVATION

A. General Requirements

1. Stabilize and support all faces of the trench excavation as specified in Section 31 50 00.

2. Control groundwater as specified in Section 31 23 19.

3. Clear, grub, and strip construction area as necessary to remove all vegetation and top soil as specified in Section 31 10 00.

B. Open Trenches

1. Open Trench Limitations: Unless otherwise indicated or required by the Agency having jurisdiction limit open trenches as follows:

2. Paved surfaces, travelled ways, roadways, and shoulders:

a. Do not open more than 300 lineal feet of excavated trench at any one time during the Work shift.

b. Up to 50 feet of trench as measured at the surface may remain open during any non-work shift, provided:

1) The entire trench opening is covered with steel plates, secured to avoid movement, and the edges backfilled with temporary pavement to provide a smooth transition.

2) Shoring is installed to prevent collapse of the trench excavation.

3. Open areas: Do not open more than 300 lineal feet of excavated trench at one time.

4. Open Trench Safety Requirements:

a. Erect traffic barricades and warning lights meeting safety requirements of Oregon Standard Specifications for Construction Section 00221 where open trench is within 12 feet of any public travelled way.

b. Erect signs to warn oncoming vehicles of rough road or steel plates in road, as appropriate.

c. Provide fencing or warning tape to protect the public and plant staff from open trench in open areas.

C. Trench Excavations

1. Excavate trenches and maintain excavation such that pipe and pipeline accessories are installed in an open trench.

2. Excavate to subgrade elevation and to trench width dimensions indicated on the Drawings.

3. Excavate all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution of the trenching Work unless otherwise indicated.

4. Where pipelines are to be installed in embankments, fills, or structure backfills, construct fill to a level at least one foot above the top of the pipe before the trench is excavated.

5. Trench shield:

a. If a moveable trench shield is used during excavation operations widen the trench width so that the shield is free to be lifted and then moved longitudinally without binding against the trench sidewalls.

b. If the trench walls cave in or slough, the trench shall be excavated as an open cut excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

D. Trench Bottom: Excavate and shape trench bottoms to provide uniform subgrade for placement of Bedding Material.

1. Unsuitable Hard Trench Bottom: If bottom of excavation is found to consist of rock or any material that cannot be excavated to provide uniform bearing surface:

a. Notify Engineer of the conditions encountered and obtain concurrence that an unsuitable trench bottom condition is present.

b. Remove such rock or other material to a depth of not less than 3 inches below the original design elevation of the bottom of the trench.

c. Place bedding material to restore the trench bottom to the original design elevation. Place in lifts not exceeding 8 inches in un-compacted thickness and compact to 90 percent of maximum dry density.

2. Unsuitable Soft Trench Bottom: If bottom of excavation is found to consist of soft or unstable material which is incapable of properly supporting pipe:

a. Notify Engineer of the condition encountered and obtain concurrence that an unsuitable trench bottom condition is present.

b. Place subgrade stabilization material wrapped with filter fabric. Compact until well keyed.

3. Wet Trench

a. Place a minimum of 12 inches of subgrade stabilization material wrapped in geotextile. Compact until well keyed.

4. Over-excavation

a. Over-excavation to a depth 6 inches or less below the design trench bottom shall be done at no additional cost to the Owner.

b. When the over-excavation ordered by Engineer is greater than 6 inches below the limits shown, additional payment will be made to Contractor. Additional payment will be made under separate unit price bid items for over-excavation if such bid items have been established. Otherwise, payment will be made in accordance with a negotiated price.

c. Measurement and Payment:

1) Measurement of quantities for payment of over-excavation will be by calculation by Engineer of the volume of materials removed as additional excavation, including additional material that must be excavated from slopes. Such calculation shall be based on the difference between dimensions before and after the additional excavation work. No compensation will be made for removal of materials beyond the limits of the additional excavation ordered by Engineer or for materials which may come into the excavation from outside the designated limits. No compensation will be made for removal of materials that are outside of the minimum horizontal dimensions indicated, even if Contractor has excavated wider than the minimum indicated.

2) Payment for over-excavation will be made by the cubic yard. The payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in excavating and backfilling the over-excavation completely, to a level at the bottom of the pipe bedding indicated. Payment shall also include full compensation for the removal and disposal of the excavated materials, import and installation of the backfill materials, control of water in the excavation, excavation support, and all costs associated with the interruption of construction operations during the review of the foundations, excavation, backfill, and all other operations required for, or as a result of, over-excavation.

5. Over-excavation not ordered by the Engineer:

a. Any over-excavation carried below the grade ordered or indicated, shall be backfilled to the required grade with the indicated material and compaction. Such work shall be performed by Contractor at no additional cost to Owner.

3.04 EXCAVATION FOR MANHOLES, VAULTS AND OTHER PIPELINE STRUCTURES

A. Unless otherwise indicated, provide excavations sufficient to leave at least 12 inches clear between structure outer surfaces and the face of the excavation or any shoring which may be used to support the face of the excavation.

B. Excavate to the subgrade soils beneath the bottom of the structure or bottom of crushed rock layer where indicated.

C. Scarify the top subgrade soils to a depth of 6 inches, moisture condition, and re-compact to 90 percent of maximum dry density.

3.05 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, protect trees from injury during construction.

B. Do not cut tree roots over 2 inches in diameter without permission of the Engineer.

C. Support trees during excavation by means approve by the Engineer.

3.06 ROCK EXCAVATION

A. Perform rock excavation in accordance with Section 31 23 16..

3.07 WARNING TAPE INSTALLATION

A. Install warning tape and tracer wire as indicated.

B. Install warning tape centered on the pipe one (1) foot above the pipe unless otherwise indicated.

C. Overlap warning tape ends a minimum of twelve (12) inches.

3.08 TRACER WIRE INSTALLATION

A. Install tracer wire on all pipe unless otherwise indicated.

B. Install tracer wire to form an electrically continuous line.

C. Secure tracer wire to the top center of the pipe at a minimum interval of 5 feet and at each change in direction.

D. Extend the tracer wire to the surface at valve boxes, hydrants, blow-off valves, air valves and other appurtenances and loop back to the pipeline such that there is a continuous wire from end to end. Provide 12 inch pigtail in the valve or appurtenance box and 12 inch pigtail adjacent to the base of hydrants.

E. Provide 12 inch pigtail at the termination of each run of pipe included in the project. Where there is no appurtenance to be provided, install a valve box to contain the pigtail.

3.09 BEDDING ZONE

A. Bedding Material: As scheduled herein or as indicated on the Drawings

B. Depth of Bedding Material: As indicated on the Drawings.

C. Place Bedding Material in a single lift, and at uniform density, with minimum possible compaction. Grade material to allow installation of the pipe at the design elevations.

D. Depressions for Assembly of Joints

1. Dig holes for bell or coupling assembly after Bedding Material has been placed at the trench bottom and fine graded to the design elevation.

2. Create sufficient width and depth to provide ample room for tightening bolts, welding, or other joint assembly activities.

3. Excavate holes only as necessary in making joints. Ensure that pipe rests upon prepared trench bottom and is not supported by any portion of the joint.

3.10 PIPE ZONE

A. Pipe Zone Material: As scheduled herein or as indicated on the Drawings.

B. Dimensions of Pipe Zone Material: As indicated on the Drawings.

C. After the pipe is laid, place material within the Pipe Zone in lifts:

1. Place backfill only after all water is removed from the excavation and the trench sidewalls have been dried to a moisture content suitable for compaction.

2. Immediately prior to placing backfill materials remove all loose, sloughing, or caving soils and rock materials from the trench.

3. Place in lifts not exceeding 8 inches in un-compacted thickness and compact to 90 percent of maximum dry density. Maintain level backfill on each side of pipe.

4. Do not dump backfill materials directly on the pipe.

D. Pipe Displacement

1. Take necessary precautions in placement and compaction of to prevent displacement of piping.

2. In the event there is movement of the pipe, excavate and re-lay the pipe.

E. Consolidation:

1. Do not use water-settling methods to consolidate trench backfill materials.

2. Use mechanical means, shovel slicing or vibratory compaction, to compact granular backfill materials under pipe haunches.

3.11 TRENCH ZONE

A. Trench Zone Material: As scheduled herein or as indicated on the Drawings.

B. Dimensions of Trench Zone Material: As indicated on the Drawings

C. Backfill voids that may form when removing shoring and bracing.

D. Do not use water-settling methods to consolidate Trench Zone Material.

E. Under Existing Crossing Pipes or Conduits Larger than 3 Inches in Diameter

1. Backfill from the top of the Pipe Zone to the spring line of the intersecting pipe or conduit with Aggregate Base or Pipe Zone material. Place in lifts not exceeding 8 inches in compacted depth and compact to 90 percent of maximum dry density.

2. Extend Pipe Zone material 2 feet on either side of crossing pipe or conduit to 6 inches above the top of the crossing pipe.

3. Backfill remainder of trench as described in this Section.

3.12 FINAL BACKFILL ZONE

A. Unless indicated otherwise on the Drawings, restore the Site to the topography that existed prior to construction by excavation, compaction, finish grading and other earthwork operations, as necessary, for the areas affected by construction.

B. Backfill with stockpiled topsoil in all areas where the original topsoil was removed as part of the site preparation and construction activities.

C. Restore all drainage swales and water courses to their original alignments and grades.

D. Install and maintain for a period of at least one year following completion of construction in any area, the facilities and management practices required by the Project Storm Water Pollution Prevention Plan, if any.

E. Install and maintain for a period of at least one year following completion of construction in any area, the measures required by the environmental permitting Drawings, permits, and approval documents of the agencies that have issued permits for construction of the Project.

F. Inside road rights-of-way:

1. Unless otherwise indicated on the Drawings or required by the agency having jurisdiction of the road right-of-way, complete trench backfill as follows:

a. Place in lifts not exceeding 12 inches in un-compacted depth.

b. Compact to 90 percent of maximum dry density except compact to 95 percent the upper 24 inches below the finished grade.

c. Replace aggregate base course to match existing aggregate base course thickness.

d. Replace final surface as indicated on the Drawings, match existing thickness, or as required by the agency having jurisdiction of the right-of-way, whichever is greater.

G. Outside road rights-of-way:

1. Areas with unpaved surfaces:

a. Place final backfill in lifts not exceeding 12 inches in un-compacted depth and compact to 90 percent of maximum dry density.

b. In Open Areas, replace topsoil with material that was removed and stockpiled prior to trench excavation.

2. Paved plant areas or driveways:

a. Backfill in lifts not exceeding 12-inches in un-compacted depth and compact to 90 percent maximum dry density except compact the upper 24 inches to 95 percent.

b. Replace final surface as indicated on the Drawings or match existing thickness, whichever is greater.

c. Replace driveway materials in kind.

d. Match pre-construction condition or better.

e. Smooth and compact material as required to create a smooth and firm driving surface.

3.13 CONCRETE PIPE ENCASEMENT

A. Provide concrete pipe encasement where indicated on the Drawings.

B. Concrete: 2,000 psi

C. Provide temporary bulkheads to contain concrete at each end of encasement. Remove temporary bulkheads after concrete has set.

D. Install reinforcing steel, where indicated, in accordance with Section 03 30 00.

E. Mix and place concrete in accordance with Section 03 30 00.

F. Control placement of concrete to prevent movement of the pipe from either displacement or buoyancy forces.

G. Support pipeline on concrete blocks, sand bags, or pre-mixed cement bags unless otherwise noted. Place supports a minimum of 10 feet on center.

H. Maintain groundwater removal, as necessary, at least until completion of concrete placement.

I. Do not place backfill on top of concrete within 4 hours of the completion of concrete placement.

3.14 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. Provide CLSM backfill where indicated on the Drawings.

B. Provide temporary bulkheads to contain CLSM at each end of cement slurry backfill segments. Remove temporary bulkheads after slurry has set.

C. Control placement of CLSM backfill to prevent movement of the pipe from either displacement or buoyancy forces.

D. Support pipeline on concrete blocks, sand bags, or pre-mixed cement bags unless otherwise noted. Place supports a minimum of 10 feet on center.

E. Maintain groundwater removal, as necessary, at least until completion of CLSM backfill placement.

F. Do not place backfill on top of CLSM backfill within 4 hours of the completion of CLSM placement.

3.15 STRUCTURE BACKFILL

A. Provide Structure Backfill material within 12-inches of all structures to be backfilled unless otherwise indicated.

B. Place a 12-inch layer of structure backfill material below all structures, unless otherwise indicated.

C. Do not drop backfill upon any structure or pipe.

D. Confirm concrete structures have attained sufficient strength to withstand the backfill loads imposed prior to placing backfill.

E. Do not place backfill around water retaining structures until structures have been tested and approved for backfill. Fill structures with water during backfill operations.

F. Place backfill after all water has been removed from the excavation and the excavation sidewalls and subgrade soils have dried to a moisture content suitable for compaction.

G. Remove all loose, sloughing, or caving soils and rock materials prior to placement of backfill.

H. Place geotextile fabric as indicated.

I. Promptly after removal, fill voids created by the extraction of sheetpile or shoring with sand-cement grout that conforms to Section 03 60 00.

J. Place backfill and spread evenly in layers so that when compacted layers do not exceed thickness indicated.

K. Thoroughly mix layers as necessary to promote uniformity of material in each layer.

L. Add water to backfill material where moisture content is below the optimum moisture content and mix with the soil until the proper moisture content is achieved throughout the soil layer.

M. Compact backfill to 90 percent of maximum dry density except compact to 95 percent in the upper 24-inches below the finished grade.

3.16 COMPACTION REQUIREMENTS

A. Compaction requirements specified herein are in-place densities of compacted backfill.

B. Initial Trench Backfill Compaction Demonstration

1. Demonstrate adequacy of compaction equipment and procedures within the initial 100 lineal feet of trenching work.

2. Continued Compaction Requirements: When specified degree of compaction is achieved, proceed with trenching and backfilling activities using the established equipment and procedures.

3.17 DISPOSAL OF SPOILS

A. Dispose of spoils and unsuitable materials in a lawful manner at an off-site location.

B. A spoils disposal area has not been identified for this project. It is Contractor's responsibility to identify spoils disposal areas and to negotiate all agreements necessary and pay all costs to dispose of spoils.

C. Obtain written permission and landowner agreements that allows the disposal of spoils and contains language that states that Owner, Engineer, and Design Consultant shall not be liable for any claims or damages resulting from Contractor's use of properties for disposal of spoils.

D. Prior to removal of any materials from the project site, provide copies of permits, landowner agreements, and approvals to Engineer.

3.18 FIELD QUALITY CONTROL

A. Cost of compliance testing: By Owner with coordination and scheduling by Contractor.

B. Frequency of testing: Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements specified.

C. Contractor's responsibilities:

1. Coordinate compaction testing and compliance with Owner.

2. Submit copies to the Owner of compaction testing results for compaction testing conducted by others.

3. Remove overburden above level at which the Engineer wishes to test.

4. Provide trench support and groundwater removal.

5. Backfill and re-compact material after testing is completed.

6. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:

    a. Remove and replace backfill at proper density.

    b. Bring density up to specified level by other means acceptable to the Engineer.

    c. Redo trench backfill compaction demonstration and demonstrate compaction process achieves required results.

    d. Costs of retesting to confirm compliance: By the Contractor.

D. Frequency of trench backfill compaction confirmation testing:

1. Each test location: Perform tests for each type or class of backfill from bedding to finish grade, excluding controlled low strength material (CLSM)

2. Non-paved roadways: 1 test every 100 linear feet.

3. Crossing paved roadways: 2 tests at each crossing.

4. Inside road rights-of-way and paved plant areas:

    a. 1 test every 100 linear feet.

    b. As required by the Agency having jurisdiction over the right-of-way.

3.19 SCHEDULE

A. Construct pipeline using materials specified in the following schedule. Where options are provided, Contractor may select materials from the materials listed.

1. Bedding Zone:

    a. Structural Fill – 3/4 inch minus Dense Graded Aggregates as Defined in Section 02630-10 of the Oregon Standard Specifications for Construction

    b. Controlled Low Strength Material

2. Wet Trench:

    a. Subgrade Stabilization material wrapped with reinforcement geotextile

3. Embedment Zone:

    a. Structural Fill – 3/4 inch minus Dense Graded Aggregates as Defined in Section 02630-10 of the Oregon Standard Specifications for Construction.

    b. Controlled Low Strength Material

4. Trench Zone:

    a. Structural Fill – 3/4 inch minus Dense Graded Aggregates as Defined in Section 02630-10 of the Oregon Standard Specifications for Construction Controlled Low Strength Material

B. Structure Backfill:

1. Bedding:

a. Structure Backfill Material - Open Graded Aggregate as defined in Section 2630.11 of the Oregon State Standard Specifications for Construction

2. Structure backfill:

a. Structure Backfill Material - Open Graded Aggregate as defined in Section 2630.11 of the Oregon State Standard Specifications for Construction

END OF SECTION

SECTION 31 23 16.26

ROCK EXCAVATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rock excavation exceeding the capability of conventional equipment.

B. Blasting requirements.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittals
2. Section 31 00 00 – Earthwork
3. Section 31 23 16.13– Trenching

1.03 DEFINITIONS

A. Rock Excavation.

1. General:

a. Removal of solid material which by actual demonstration cannot, in Owner's Representative's opinion, be reasonably removed using conventional excavation equipment and must be systematically broken by power-operated hammer, hydraulic rock breaker, expansive compounds, blasting, or other similar means prior to removal.

b. For excavation of solid material that cannot be removed using an excavator or tractor in good working condition having a minimum flywheel power of 220-mechanical horsepower (164 kilowatt) and equipped with manufacturer's standard boom, single tooth rock ripper, and rock points on a rock ripping bucket no wider than 36 inches, or similar approved equipment, will be considered rock for the purpose of payment.

2. Term "rock excavation" indicates removal of solid material, as specified above, and does not necessarily correspond to "rock" or "bedrock" as implied by names, geologic formations, or other definitions provided in the Oregon Standard Specifications for Construction or other documents outside of this specification.

1.04 SUBMITTALS

A. Submit the following shop drawings, plans and product information per Section 01 33 00:

1. Permits: The Contractor shall obtain all required local, State, Federal, and the utility owners' permits and shall submit to the Owner's Representative, a copy of all applicable permits for transportation, storage, and use of explosives.

2. At least 28 days prior to drilling any blast hole, the submit the resumes for the Owner's Representative's approval the resumes of the Contractor's Blasting

Consultant, Blasting Supervisors (Blasters-In-Charge), and personnel performing preconstruction blast surveys.

3. At least 28 days prior to drilling any blast holes, the submit a Project-specific General Blasting Plan to the Owner's Representative for review. The Contractor's Blasting Consultant shall visit the Site and prepare the Plan. The plan should include:

    a. A scaled plan drawing showing the approximate location and extent of the Contractor's blasting operations.

    b. A schedule of neighborhood pre-blast advisories, notifications and pre-blast structural surveys; a description of shot clearing and guarding procedures.

    c. A description of the anticipated road closures required during blasting operation,

    d. A tabulation of the nearest distances to structures within the specified blast generated seismic influence zone.

    e. A description of the drill and blast operation providing: the blast hole diameters and range of depths, the types of explosive to be used, the length of the stemming columns and the type of stemming material, the type of initiation system to be used, the methods used to control fly rock and sufficient information to determine the acceptability of the proposed blasting, and conformance with Paragraph 3.03.D, Blasting Limitations, hereinafter.

4. For each kind of blasting agents and explosives to be used, submit the perchlorate content provided by the suppliers and/or manufacturers. The Contractor has to obtain written permission from the Owner's Representative to use perchlorate-containing explosive products.

5. At least 14 days prior to drilling any blast holes the submit to the Owner's Representative manufacturer's product information sheets and Material Safety Data Sheets (MSDS) for all explosives, blasting agents, primers, and initiating products the Contractor proposes to use.

6. At least 24 hours before drilling any blast holes, the submit a Site-Specific Pre-blasting Blast Plan to the Owner's Representative for review and approval. The Pre-blasting Site-Specific Blast Plan shall include the following minimum information:

    a. A Site-specific plan view showing the blast area(s) and distances from the blast to all structures within 300 feet. The plan shall show the locations and distance to buried structures including buried utilities and pipelines within 100 feet of blast areas. Should the rock excavation require more than one blast, the plan shall show the anticipated footprint of each blast and the sequence in which the blasting will occur.

    b. A section view or profile of the blast area showing the top of ground, the rock/overburden contact and the bottom elevation limits of the excavation.

c. The maximum weight of explosives to be detonated in any discrete 8 millisecond incremental time period.

7. Review and approval of any blasting plan by the Owner's Representative shall not relieve the Contractor of their responsibility for obtaining adequate rock breakage and limiting rock breakage to within the design excavation final lines and grades.

8. Submit a Blast Report Form or approved equal to the Owner's Representative before 9 am the day following each blast. The report shall contain the information required in Paragraph 3.03.G, Blasting Records.

9. Pre-blast Survey: At least 7 days prior to loading blastholes, submit Pre-blast Inspection Report including the information described in Section 1.07.

1.05 REFERENCES

A. Oregon Occupational Safety and Health Code (OR-OSHA), Division 3 Construction, Subdivision U – "Blasting and Use of Explosives," Sections 1926.900 through 1926.914.

B. Oregon Revised Statutes for Explosives, 480.010 through 480.290 and Administrative rules 837-12-1200 through 837-12-1420. The rules are administered by Oregon's Office of State Fire Marshal and govern the sale, possession, transfer of explosives, and the required certificates.

C. Code of Federal Regulations (CFR): Bureau of Alcohol, Tobacco, and Firearms (ATF): 27 CFR 555.

D. National Fire Protection Association:

1. 495: Explosive Materials Code.

E. Blast Vibration Monitoring:

1. International Society of Explosive Engineers (ISEE), 2011, Blaster's Handbook, 18th edition, Appendix E, Seismograph Field Practice Guidelines.

1.06 QUALIFICATION OF BLASTING PERSONNEL

A. Provide the services of an independent, qualified Blasting Consultant, experienced in controlled and sinking cut blasting techniques for similar civil and hydraulic works, to prepare blasting plans, to supervise the installation of instruments, and to supervise the interpretation of recorded results. The Blasting Consultant shall have at least 10 years of experience and demonstrate satisfactory experience on 5 similar projects. These projects shall include blasting within 100 feet of occupied dwellings or utilities where good relations with owners of nearby private structures or utility and the public were maintained. The Blasting Consultant shall not be an employee of the Contractor, explosives manufacturer, or explosives distributor. The Owner's Representative shall review and approve or reject the Blasting Consultant.

B. Use experienced, competent Supervisors (Blasters-In-Charge) for all blasting operations. All blasting supervisors shall have at least 10 years of experience and be able to demonstrate satisfactory experience on at least 5 similar projects, including blasting within 100 feet of occupied dwellings or utilities. All blasters and blasting supervisors shall be properly qualified and licensed in accordance with applicable federal, state, and local

regulations. The Contractor shall not allow prohibited persons as defined by the BATF (27 CFR Part 555) to transport, handle, or use explosive materials.

C. Use experienced and qualified personnel for conducting pre-blast condition surveys. Personnel conducting pre-blast surveys shall have at least 5 years of experience in conducting pre-blast condition surveys of structures and be able to demonstrate satisfactory experience on at least 3 similar projects. Personnel conducting pre-blast surveys shall be the employees of a firm regularly engaged in conducting such surveys and shall not be an employee of the Contractor or any explosives manufacturer or distributor.

1.07 QUALITY CONTROL AND ASSURANCE

A. Pre-blast/Post-blast Inspections:

1. Coordinate all necessary notifications with utility owners of any utilities within 100 feet of the blast.

2. Prior to blasting, inspections shall be made of residences and other private structures existing within a 300-foot radius of all blasting locations. Notify the Owner's Representative at least 7 days prior to the inspections so a representative of the Owner's Representative may be present.

3. Inspections shall meet the following conditions: The survey shall include documentation of interior subgrade and above grade accessible walls, ceilings, floors, roof, and visible exterior as viewed from grade level. It shall detail by videotape or photographs and notes and sketches the existing condition or structures. Existing crack damage, other structural problems or defects occurring inside and outside the structure shall be documented as follows:

   a. The location of the feature shall be noted on a scaled drawing,

   b. Feature dimensions (e.g. width, length, depth) shall be measured and documented.

   c. Feature shall be photo-documented. A scale such as a ruler or crack meter shall be included in the photograph.

4. Develop a pre-blast inspection report, including videotapes and photographs, and shall be submitted to the Owner's Representative. Photographs shall be electronically imported and included in the report. Scans of photographs shall not be allowed.

5. As construction progresses, reinspect, as often as necessary to verify that controlled blasting methods are not causing any new damage.

6. In the event any property owner denies access for the survey of structures within the specified limits, notify such property owner by certified mail, on the intent of the survey. If after 2 weeks, access is still denied, notify the property owner once again that this is the final notification. Submit two copies of all such correspondence to the Owner's Representative. Upon review of the correspondence, the Owner's Representative may waive the inspection requirements for property owned by the owners refusing access.

7. Post blast inspections shall be required for property where written or verbal damage complaints were made by property owners.

B. Damage Repair

1. In case damage from blasting occurs to existing structures, to any portion of the Work, or to the material surrounding or supporting the same that is intended to remain, remove such damaged Work, repair the work, and replace the material and perform such Work for repair or replacement as the Owner's Representative deems necessary. Repair all damage promptly, completely, and satisfactorily, at the Contractor 's sole expense.

2. Nothing contained herein shall relieve the Contractor of their responsibility for claims arising from the Contractor's construction operations, including blasting operations. Failure to inspect any structure required by these Contract Documents, or inadequacy of inspections shall not relieve the Contractor of their responsibility. The Contractor shall indemnify the Owner and the Owner's Representative for such claims.

1.08 SAFETY REQUIREMENTS

A. Explosives shall be handled, transported, used, controlled, and monitored as prescribed by the most stringent of rules specified in the referenced OSHA and ATF Standards, Oregon's Office of State Fire Marshal explosives regulations, this Section, and local codes and ordinances.

B. Keep explosives on the Site only in such quantity as needed for Work under way and only during time as being used. No overnight magazine storage of explosives shall be allowed within the Project limits. Only the amount of explosives to be used each day shall be on the Site. Promptly remove from premises remaining unused explosives and explosive product packaging materials when need for explosives has ended. All loaded blast holes are to be shot the day they are loaded.

C. Conform to State, Federal, and municipal laws, ordinances, and regulations relating to transportation, handling, and use of explosives. If any of above-mentioned laws, ordinances, or regulations require a licensed blaster to perform or supervise the Work of blasting, employ a licensed blaster. Require them to have a license on Site and permit examination by Owner's Representative or other officials having jurisdiction.

D. Conduct operations involving explosives with all possible care to avoid injury to persons and property. Do blasting only with such quantities and strengths of explosives and in such manner as will break rock approximately to intended lines and grades, leaving rock not to be excavated in an unshattered condition. Avoid excessive cracking of rock upon or against which any structure will be built. Prevent injury to existing pipes, structures, and property above or below ground. Cover rock with logs or mats, or both. Give sufficient warning to persons in vicinity of Work before a charge is exploded.

E. Complete blasting within a distance of 50 feet (15 m) before any portion of a masonry structure is placed or any pipe is laid.

F. Determine presence of two-way-radios, stray electrical currents and other conditions adversely affecting blasting operations and implement necessary precautions to prevent accidents and premature blasts.

1.09 SITE CONDITIONS

A. Protect structures, underground utilities, and other construction from damaged caused by blasting.

B. Subsurface conditions at the wastewater treatment plant are described in the Geotechnical Data Report prepared for this Project – see Supplementary Information in Volume 3 of the Contract Documents. It is the responsibility of the Contractor and the Contractor's Blasting Consultant to review and understand the rock mass characteristics at the Site.

PART 2 - MATERIALS

2.01 EXPLOSIVE PRODUCTS

A. To the extent practical, avoid the use of perchlorate-containing explosive products when surface or groundwater can be affected.

2.02 WARNING SYSTEMS

A. Institute a system of audible signals to warn of impending blasts.

B. Erect signboards of adequate size stating that blasting operations are taking place in the area. Such signs shall be clearly visible at all points of access to the area and shall clearly describe the audible signal system for warning of impending blasts.

C. Mark all day storage places and explosives transport vehicles with signs stating clearly and boldly, DANGEROUS EXPLOSIVES.

2.03 BLAST MONITORING INSTRUMENTATION

A. The Contractor with the assistance of the Contractor's Blasting Consultant shall provide and operate a minimum of three blast monitoring seismographs, at locations shown on the Drawings, to record particle velocity simultaneously along three mutually perpendicular axes.

B. Provide and operate a minimum of two approved air blast overpressure/sound monitoring devices at locations as directed by the Owner's Representative.

C. Blast monitoring instrumentation shall be 4-channel, (1 overpressure and 3 seismic channels) units capable of digitally storing collected data. Equipment shall be capable of printing ground motion time histories and summaries of peak motion intensities, frequencies, and USBM RI8507 ppv-frequency plots. Printed report records shall include date, time of recording, operator name, instrument-number, and date of last calibration. Instruments shall have a flat frequency response between 2 and 250 hertz (Hz) for particle velocity and from 2 to 200 Hz for air pressure.

D. Seismographs shall be capable of recording overpressure from 88 to 148 decibels (dBL), and a particle velocity from 0.005 to 10.0 ips, and shall be capable of performing a self-test of velocity transducers and printed event record shall indicate whether or not the sensor test was successful.

E. Blast monitoring equipment shall have been calibrated within 1 year of any blast monitoring.

F. Blast vibration monitoring shall be performed in general agreement with the 18th edition of the Blaster's Handbook, Appendix E, Seismograph Field Practice Guidelines, published by the International Society of Explosive Engineers (ISEE), 2011.

2.04 BLASTING MATS

A. Blasting mats shall weigh at least 25 pounds per square foot. Mats shall be a minimum of 6 feet by 10 feet and shall be equipped with suitable placement attachments.

PART 3 - EXECUTION

3.01 ROCK EXCAVATION

A. Conduct excavation in accordance with Section 31 00 00 or Section 31 26 16.13.

B. If material is encountered that cannot be excavated by conventional equipment, notify Engineer immediately. Provide performance tests of the specified conventional or equivalent equipment demonstrating the equipment can perform to at least the level specified. If Engineer confirms in writing that the specified conventional equipment cannot perform at the production rates specified, the excavation shall be considered rock excavation.

C. A boulder may be considered rock excavation if, after the boulder has been exposed by excavation on all sides, neither type of conventional equipment can break up the boulder into pieces sufficiently small to enable removal by the specified equipment.

3.02 MEASUREMENT AND PAYMENT

A. Payment for rock excavation will be as provided in the Bid form as a unit price item for quantities in excess of the base bid quantity included in Contractor's lump sum bid. Payment for additional rock excavation shall be at the additive or deductive unit prices provided on the Bid Form.

B. Measurement and Payment

1. Measurement of quantities for payment of rock excavation shall be by calculation by Engineer of the volume of in-place materials removed as rock excavation. No compensation will be made for removal of materials beyond the limits of the rock excavation in the project drawings or ordered by Engineer or for materials which may come into the excavation from outside the designated limits. No compensation will be made for excavation wider or deeper than the minimum indicated.

2. Payment for rock excavation will be made by the cubic yard unless otherwise indicated. The payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in excavating and backfilling the excavation completely, subgrade elevation indicated. Payment shall also include full compensation for the removal and disposal of the excavated materials, control of water in the excavation, excavation support, performance tests, costs associated with interruption of construction operations during performance tests and confirmation by Engineer, costs associated with the additional time required for excavation, and all other costs and operations required for, or as a result of, rock excavation.

3.03 EXPLOSIVES AND BLASTING

A. General

1. Conduct blasting, storage and handling of explosives in accordance with the Oregon Occupational Safety and Health Division (Oregon OSHA), Oregon Administrative Rules, Chapter 437, Division 3 Construction, Subdivision U, and Section 00335 of the Oregon Standard Specifications for Construction and any other authorities having jurisdiction.

2. Obtain all necessary permits and furnish copies to Engineer before explosives are transported to the Site.

3. Pay for permits at no additional cost to Owner.

4. Perform blasting only by skilled operators under the direction of a licensed blasting supervisor.

5. Submit blasting plan prepared by qualified person. Blasting plan to include

   a. Details of drilling and blasting pattern

   b. Vibration, flyrock and noise reduction methods

   c. Blast area security measures

   d. Traffic control

6. Identify all property, structures, and persons that may be affected by blasting and take all safety precautions and protective measures to prevent damage or injury to same.

7. All personal injury or damage to persons or property of any nature, whether in the Work or appurtenant to it, shall be the responsibility of Contractor.

8. Contractor agrees by submission of a bid to indemnify and hold Owner, its officers, agents, employees, and Engineer harmless from any and all liability claims, costs, and expenses as a result of blasting operations, including expenses of investigation and defending against same in regard thereto.

9. Perform basting only between 9:00 AM and 4:00 PM, Monday through Friday, except legal holidays, unless otherwise approved by Engineer and regulatory agencies having jurisdiction.

B. Blasting

1. Perform instrumented seismographic monitoring of blasting.

   a. Place a seismograph at the nearest structure to the blast to monitor the ground motion particle velocity and frequency during each blast.

   b. Provide one copy of each seismograph chart to Engineer.

   c. If blast results in unacceptable vibrations modify the blasting procedure.

2. Contain fly rock from blasting within the project site and prevent hazard to persons, vehicles, existing improvements, or vegetation.

3. Clean the blasting site of all debris at the end of each day.

4. Do not blast within 100 feet of concrete that has cured less than 7 days.

C. Blasting Limitations

1. The following limitations are mandatory for all blasting operations:

2. Road Closure Limitations:

   a. Road closures are required during blasting all blasts. Submit any anticipated road closures in the General Blasting Plan, per Paragraph 1.04 of tis Section. Traffic control for the road closures shall be in accordance with the most recent ODOT Traffic Control Plan Design Manual.

3. Work Hour Restrictions

   a. Blasting shall be performed between XX am and XX pm. No nighttime blasting shall be allowed.

D. Blasting Safeguards

1. The maximum charge weight per 8 millisecond (MS) delay shall be in accordance with the Scale Distance Formula, $W= (D/Sd)^2$, where W = weight of explosives per 8 MS delay, D = distance in feet to structure, Sd = selected scaled distance from test blasting, unless otherwise specified by the Owner's Representative.

2. The maximum charge weight per 8 millisecond delay (MS) delay shall be approximated by the use of the following equation, which shall be refined based on test blasts and experience gained as the Work progresses: $W = D^2 * (V/H)^{1.25}$, where W = maximum weight of explosives per delay period of 8 MS, in pounds, V = peak particle velocity, in inches per second, D = shortest distance between blast and the point of interest in feet and H = ground response factor, which equals 70 (unit-less) and shall be verified by test blasting, unless otherwise specified by the Owner's Representative.

3. The first blasting operation at each location shall be monitored by the Contractor as a test case, and the proper drill and blast parameters subsequently used shall be derived from the test results. The Scaled Distance for test shots shall be based on the Contractor's General Blasting Plan and such that the peak particle velocity at the nearest residence, private, public, community, or institutional building does not exceed 2.0 inches per second, or as directed by the Owner's Representative. Blast monitoring shall be continued for every blast round. Blast monitoring data recorded for each shot shall be furnished to the Owner's Representative prior to drilling for the next blast. Changes in drilling patterns and amount of explosives shall be made when records indicate vibration in excess of that specified herein.

4. If the measured air overpressure exceeds 0.014 psi (133 dB) at the nearest occupied dwelling adjacent to the blast zone or other designated location, the Owner's Representative may require up to a 3-day shutdown of Contractor's operations for inspection of facilities. This delay shall be at no additional cost to the Owner and shall not constitute the basis for any claim.

5. If for any blast, the measured peak particle velocity or airblast exceeds the limits in this specification, the Contractor's Blasting Specialist shall review the Contractor's blasting methods and the Contractor shall submit a revised Blasting

Plan for the Owner's Representative's approval to conducting additional blasting activities.

6. In reporting a shot, the distance from the shot to each recorder, the amount of explosives used in each delay, the total amount of explosives used, and the time shall be noted. No separate or direct payment shall be made for monitoring of blasts, as all costs shall be considered incidental to, and included in, the applicable items of the Contract.

7. Cover the area to be shot with blasting mats or other approved type of protective material that will prevent the scattering of rock or other fragments. Give ample warning to all persons within the vicinity prior to blasting and provide signals warning of danger in suitable places to alert people in vehicles before firing any blasts. If flyrock projects past the guarded area of the shot or lands on private property, all blasting operations shall cease until the Contractor's Blasting Consultant reviews the Site and determines the cause of the flyrock and submits a revised shot plan for the Owner's Representative's approval.

8. After a blast has been fired, the blaster shall make a careful inspection to determine that all charges have exploded before employees are allowed to return to the operation. Misfires shall be corrected in accordance with the requirements of the applicable portions of Federal, State, and/or local safety codes for blasting. The Contractor shall be responsible for any and all damages to property or injury to persons resulting from blasting, or accidental or premature explosions that may occur in connection with the use of explosives.

9. All loose and shattered rock or other loose material, which may endanger any structure or the workers, shall be removed and the excavation made safe before proceeding with the Work. After muck removal and before drilling of blast holes for a new round, the face shall be cleaned and thoroughly examined for missed holes and unexploded powder. Blasting techniques shall be developed and improved as Work progresses. The fact that the removal of loose or shattered rock or other loose material may enlarge the excavation beyond the required limits shall not relieve the Contractor of the responsibility for removal of such material.

10. Whenever, in the opinion of the Owner's Representative, proposed blasting may cause harm to persons or private property, cause damage to structures, or create rock face instability, cease blasting immediately and review the blast design. The Contractor can resume excavation of the rock after redesigned blast plan has been approved by the Owner's Representative or by mechanical methods.

E. Blasting Test Shots

1. The Contractor shall demonstrate that the proposed blasting method meets the Project objective to the Owner's Representative by making test shots.

2. Test shots may form final rock faces upon approval of the Owner's Representative.

3. The first sinking cut shot in the shaft shall be a test blast.

4. The Contractor's Blasting Consultant shall be present to witness each test blast.

5. The Owner's Representative shall be the sole judge as to the acceptability of the proposed method. If the test is unacceptable, the Contractor, with the assistance of the Blasting Consultant, shall modify their proposed blasting method and perform additional tests until the method is acceptable.

F. Blasting Records

1. Complete the Blast Report Form for each blast detonated, and be submit to the Owner's Representative along with a Blasting Ground Motion Record (seismograph and airblast record) before 9 AM of the following day after each blast. This record shall include the following:

   a. Depth of blast holes and the location of the blast point in relation to Project stationing; type and strength of explosives, type of blasting caps, and distribution of delays used; vibration record including USBM RI8507 ppv-frequency plot; total explosive loadings per round and per delay; comments by the blaster in charge regarding any misfires, unusual results or unusual effects; date and initiation time of blast; name and signature of the Blaster-in-Charge and any other records required by State, Federal, and local codes and/or regulations.

   b. Failure to submit the Blast Report Form shall be grounds for the Owner's Representative to suspend the Contractor's drilling and blasting operations until the required reports have been submitted.

G. Post-Blast Investigation and Report

1. Perform post-blast inspections of each structure included in the pre-blast survey.

2. Perform post-blast inspections with a qualified independent inspector provided by the Contractor.

3. Use pre-blast survey forms for each structure to indicate no damage has occurred as a result of the blasting operation, sign forms following inspection, and submit one copy to the Owner.

4. Where damage has occurred, investigate the damage and provide a written report to Engineer within 30 days of identification of the damage or receipt of the complaint.

END OF SECTION

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SECTION 31 23 19

DEWATERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Control of water and dewatering of trench and structure excavations.

1.02 RESPONSIBILITY FOR DESIGN

A. Assume responsibility for planning, design, installation and operation of temporary groundwater dewatering systems and temporary surface water control systems. Water control systems designed and installed by the Contractor shall adequately protect existing property, foundations and permanent structures.

B. Utilize the services of a Registered Hydrogeologist, Professional Civil Engineer, or Certified Engineering Geologist to develop the Groundwater Control Plan (GWCP) and the design of the groundwater and surface water control systems to achieve specified results. Professional registration shall be for the State of Oregon.

C. Assume sole responsibility for loss or damage resulting from partial or complete failure of operation of dewatering systems.

D. Assume responsibility for repairing damage to adjacent properties, buildings, structures, utilities and other work due to settlement or resultant damage caused by the groundwater control operations.

E. Determine means and methods for disposing of water removed by dewatering systems. If permit requirements specify water quality requirements that must be met before water can be disposed, provide the necessary treatment facilities to achieve the specified water quality limits

F. Modify groundwater control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas.

G. When additional information is needed for design of dewatering systems, conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems

1.03 RESPONSIBILITY FOR SECURING PERMITS

A. Obtain all necessary permits, including those required by Oregon Water Resources Department (OWRD) for dewatering wells and monitoring wells, a 1200-C Storm Water Discharge General Permit from the Oregon Department of Environmental Quality (DEQ) for discharge of groundwater, and those required by the City of Sweet Home for discharge to the local sewer system.

B. Pay all costs associated with permitting, decommissioning and removal of all dewatering systems when no longer in use.

C. Comply with the sampling, testing, monitoring, and reporting requirements specified in permits secured for dewatering operations.

1.04 PERFORMANCE REQUIREMENTS

A. General

1. Groundwater control systems may include single-stage or multiple-stage well point systems, sump pumps within excavations, shallow or deep wells, or combinations of these types of dewatering systems.

2. Locate groundwater control and drainage systems so as not to interfere with utilities, construction operations, vehicular traffic, adjacent properties, or adjacent water wells.

3. Modify dewatering procedures which cause, or threaten to cause, damage to new or existing facilities, so as to prevent further damage. Install settlement gauges, as necessary, to monitor settlement of critical structures or facilities adjacent to areas of dewatering. Control the rate of dewatering to avoid all objectionable settlement and subsidence.

4. Install piezometers to monitor groundwater in the area of the excavation, as well as the natural groundwater elevation. Install piezometers in the locations specified elsewhere in this Section.

5. Remove or abandon dewatering system when it is no longer needed in accordance with regulatory stipulations indicated in this Section.

B. Project Conditions

1. Anticipate encountering groundwater in all excavations.

2. Groundwater may be free-flowing into excavations or may be encountered in the form of saturated soil.

C. Requirements for Dewatering of Excavations:

1. Design dewatering systems of sufficient scope, size, and capacity to accomplish the following results:

a. Control the flow of surface water into trench and structure excavations by grading, dikes, or other means.

b. Lower groundwater levels and eliminate infiltration of groundwater into trench and structure excavations, allowing construction to proceed on dry, stable subgrade.

c. Lower and maintain groundwater below the lowest point of excavations.

d. Lower groundwater levels further when necessary to prevent flotation and damage from hydrostatic pressure and to obtain the specified degree of compaction. Develop substantially dry and stable subgrade for subsequent earthwork compaction and construction operations.

e. Prevent the loss of fines, seepage, boils, quick conditions, or softening of the foundation soils.

f. Maintain stability of sides and bottoms of excavations.

D. Requirements for Protection of Existing Structures

1. Provide, operate and maintain dewatering systems of sufficient size and capacity to protect existing structures from hydrostatic uplift when the structure is drained of water.

2. Protection against hydrostatic uplift entails lowering the groundwater table in the immediate vicinity of the structure to be drained until the groundwater elevation is at least 12 inches below the top of slab elevation of the structure.

E. Operation of Dewatering Systems

1. Maintain dewatering operations to control and minimize erosion, to create stable sides and bottoms of excavations, to stabilize constructed slopes and to prevent settlement and damage to structures and utilities.

2. Collect and dispose of removed water. Water removed by dewatering systems cannot be discharged into the storm water collection system which consists of pipes, catch basins, manholes and roadside drainage ditches. Discharge water to wastewater treatment plant. Coordinate discharge location, quality and quantities with City prior to discharge.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Comply with requirements of agencies having jurisdiction.

B. Comply with all laws and regulations for development, drilling, and abandonment of wells used in dewatering systems.

C. Obtain a 1200-C Storm Water Discharge General Permit from the Oregon Department of Environmental Quality (DEQ) under the National Pollutant Discharge Elimination System (NPDES) for discharge of collected groundwater from the construction site.

D. Obtain all necessary permits from agencies with regulatory jurisdiction over groundwater pumping, matters affecting well installation and the use of existing storm drains and natural water drainage courses.

E. Take early action and allow time for the review, as permitting processes may be lengthy. Take early action to pursue and submit for the required approvals.

1.06 SUBMITTALS

A. Notify the Owner's Representative immediately after any material change or proposed change in the character, volume, treatment or disposal methods of the discharge.

B. Additional Shop Drawings for Specific Locations

1. Submit design details of dewatering systems and water treatment systems that will be utilized at the specific locations listed herein.

2. Design of the dewatering system shall be prepared by a Registered Hydrogeologist, Professional Civil Engineer, or Certified Engineering Geologist registered in the state of Oregon and shall be coordinated with the design of the excavation support systems that the Contractor proposes to use at these locations.

3. Provide shop drawings that are signed and sealed by the responsible Engineer or Certified Professional licensed in Oregon.

4. Illustrate the arrangement, locations and details of the dewatering system, including wells and well points; dewatering pumps and piezometers; locations of headers, treatment systems and discharge lines; standby equipment and power supply; silt removal, pollution control and treatment facilities; and the means of conveyance, discharge and disposal of water.

5. Include a narrative report outlining the dewatering procedures and controls.

6. Submit a minimum of six weeks before any work referred to in the submittal is scheduled to commence.

C. Groundwater Control Plan (GWCP)

1. Proposed plan for the design, control, transport, treatment, operation, disposal of water, signed and sealed by the designer. Include with this proposed plan a drawing that indicates the number and location of the dewatering wells to be installed for the Work.

2. Include the following in the GWCP:

a. Calculations for the design of each system, including a statement of design assumptions, system description, and basic design criteria. Quantify the peak discharge rate of each system into receiving storm water and sanitary sewers.

b. Schedule and procedures for installation, start-up testing protocol, and removal of each system.

c. Location, dimensions, and capacity of wells, retention basins, treatment ponds, tanks, and treatment plants.

d. Sizes, locations, and types of discharge lines, ditches, sumps, and flow measurement devices.

e. Details of dewatering systems for shafts, including well sizes, locations, gradation of filter materials, and calculations for compatibility with screen and ground.

f. Types, capacities and numbers of pumps, generators, and standby units.

g. Design and construction of all electrical installations.

h. Details for the collection of water in tunnel and shafts, its conveyance to the treatment point, its treatment of the water, and its discharge from the site.

i. Methods of measuring the flows in accordance with the requirements specified herein.

j. List of substances that may be introduced into discharges or increased in concentration due to the Contractor's means and methods of performing the Work.

k. Methods of monitoring groundwater level and water quality to check its compliance with all regulatory requirements prior to its discharge from the site.

l. Methods for diverting or collecting, monitoring, and treating as necessary prior to discharge all storm water.

m. Methods for collecting, handling, treating and disposing of water and byproducts from excavated materials stockpiled on site.

n. Copy of approved permits (i.e. discharge permits).

o. Copies of all daily reports specified herein.

3. Timing: Submit GWCP within 21 calendar days of the Notice to Proceed.

1.07 QUALITY CONTROL

A. Qualifications:

1. Name, address, phone number and professional registration of the designer of the dewatering systems.

2. Company and individuals responsible for the operation of the facilities.

3. Independent testing laboratory responsible for testing treated effluent will be arranged for and provided by the City.

B. Certifications: Permit for discharge into local storm water and sewer systems.

C. Quality Control Plans

1. Method for assuring that water quality complies with regulatory requirements prior to its discharge from the site.

2. Methods demonstrating the ability of the automatic paging facilities, power transfer facilities, and backup systems to comply with specified requirements.

3. Methods for assuring that collection, handling, treatment, and discharge operations do not damage the Work in progress or impact the efficiency with which other Work is performed.

4. Calculations demonstrating capacity of system to store collected water on site to comply with permit restrictions for discharging.

5. Recordkeeping: Flow, water quality, and amount and type of treatment chemicals used on a cumulative basis. Provide daily, no later than 8 hours after records were taken.

D. Shop drawings of the dewatering system must be approved prior to beginning excavations.

1.08 QUALITY ASSURANCE

A. Reference Standards: Except as otherwise indicated the current editions of the following specifications and standards apply to the Work of this Section:

1. Oregon Administrative Regulations (OAR):

a. OAR 690-200, Well Construction and Maintenance.

b. OAR 60-210, Abandonment of Wells.

c. OAR 690-240 Construction, Maintenance, Alteration, Conversion and Abandonment of Monitoring Wells Geotechnical Wells, and Other Holes in Oregon.

2. Environmental Protection Agency (EPA)

   a. 40 CFR 136 - Guidelines Establishing Test Procedures for the Analysis of Pollutants.

   b. 40 CFR 261 - Identification and Listing of Hazardous Waste.

   c. 40 CFR 403 - General Pretreatment Regulations for Existing and New Sources of Pollution.

3. Qualifications:

   a. Designer of GWCP: Registered Hydrogeologist, Professional Civil Engineer, or Certified Engineering Geologist registered in the State of Oregon with a minimum of five years experience in the design, including monitoring and recording, of water collection, handling, and treatment systems similar to those required under this Contract.

   b. Installer and Operator:

      1) Company with at least five years experience in responsible charge of the installation and operation of water collection, handling, and treatment systems similar to those required for this project.

      2) Personnel operating and maintaining facilities with demonstrated experience in the operation of systems similar to those required for this project.

4. Preconstruction Meeting: Prior to beginning excavation, complete installation of the water treatment facility and arrange for a demonstration and test of all features, including automatic paging facilities, power transfer facilities and backup systems.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Furnish and maintain all materials, tools, equipment, facilities, and services as required for providing the necessary dewatering work and facilities.

B. Materials for Groundwater Extraction Wells and Groundwater Monitoring Wells:

1. Well Casing: Schedule 40 PVC or steel pipe. Size to be determined by Contractor, 8-inch minimum.

2. Groundwater Monitoring Well Casing: 2-inch diameter PVC pipe with 20 foot section of slotted screen.

3. Sand Pack: 10-20 silica sand.

4. Pump Size, Capacity, and Type (Extraction Wells): As selected by Contractor.

5. Provide locking security cap on top of well casing.

C. Collection and Discharge Pipes: Steel or PVC pipe and fittings.

D. Water Quality Treatment Equipment: Provide settling tanks with sufficient capacity for the flow rate and volume of water. Include chemical flocculation and filtration equipment as necessary to comply with water quality limits.

2.02 DEWATERING AND WATER CONTROL EQUIPMENT

A. Select equipment and materials necessary to achieve desired results for dewatering.

B. Use equipment that is in good repair and operating order.

C. Maintain sufficient standby equipment and materials available at the site to ensure continuous operation, where required.

2.03 GEOTEXTILE CONTAINMENT TUBES

A. Contractor may utilize a pervious geotextile containment tube for capturing and removing sediment from water collected during dewatering operations.

B. Tube Construction: Fabricated from woven, mono-filament or multi-filament pervious sheets of geotextile material and provided with filling ports and a pressure relief port.

C. Manufacturers: One of the following or equal:

1. Geocontainer, as manufactured by Ten Cate Nicolon.

2. Geotube, as manufactured by Texion Geosynthetics.

PART 3 - EXECUTION

3.01 NPDES PERMIT COMPLIANCE

A. Implement the Groundwater Control Plan as approved by the Oregon DEQ before beginning excavation.

B. Comply with all limitations and controls for water discharges, monitoring requirements and other special conditions specified in the permit.

3.02 MONITORING GROUNDWATER

A. Groundwater Monitoring Wells:

1. Install a minimum of three (3) groundwater monitoring wells for monitoring groundwater elevation upgradient and downgradient at each dewatering system location on the project site.

2. Measure and record groundwater elevation two times per week during the course of dewatering to lower the groundwater table.

3. When groundwater monitoring wells are no longer needed for monitoring ground water levels, abandon groundwater monitoring wells in accordance with Applicable laws and regulations.

B. Installation of Monitoring Devices

1. Construct well in accordance with the requirements of ASTM D5092, Standard Practice for Design and Installation of Groundwater Monitoring Wells.

2. Depth of Drilled Hole: Minimum 10 feet below required elevation of groundwater drawdown, or to the depth of bedrock.

3. Construction Methodology: Install monitoring wells using methods that do not use drilling mud.

3.03 DEWATERING

A. Perform dewatering in accordance with approved Shop Drawings. Keep the Owner's Representative advised of any changes made to accommodate field conditions and, on completion of the dewatering system installation, revise and resubmit Shop Drawings as necessary to indicate the installed configuration.

B. Organize dewatering operations to lower the groundwater level in excavations as required for prosecution of the Work, and to provide a stable, dry subgrade for the prosecution of construction operations.

C. Design, install and operate the dewatering systems so that fines are not removed from native subgrade and surrounding soils during dewatering.

D. Maintain water level at lower elevations, so that no danger to structures can occur because of buildup of excessive hydrostatic pressure, and provide for maintaining the water level below the subgrade, unless otherwise permitted by the Owner's Representative.

E. Maintain groundwater level a minimum of five feet below the prevailing level of backfill being placed.

F. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health. Dispose of the water in accordance with applicable regulatory agency requirements.

G. Dewatering of Pipe Trenches: Do not drain trench water through the pipeline under construction.

H. Maintain continuous dewatering operations so that the excavated areas are kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.

I. Prevent disposal of sediments to adjacent lands or waterways by employing necessary methods, including settling basins. Locate settling basins away from watercourses to prevent silt-bearing water from reaching the watercourse.

J. Where excavations may obstruct the natural flow of a watercourse, implement measures to control and dispose of the surface water that will not adversely affect water quality or beneficial uses of the watercourse. Divert watercourse flows around excavation areas by constructing barriers, temporary culverts, new channels or other appropriate means.

K. Do not allow water containing mud, silt or other pollutants from aggregate washing or other construction activities to enter a watercourse or be placed in locations that may be subjected to high storm flows.

3.04 SURFACE WATER CONTROL

A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other means. This requirement extends to temporary works required to protect adjoining properties from surface drainage caused by construction operations.

B. Implement the appropriate level of surface water control to protect water quality throughout the construction period.

C. Utilize Best Management Practices throughout the construction period.

3.05 GROUNDWATER CONTROL

A. Provide labor, material, equipment, techniques and methods to lower, control and handle groundwater in a manner compatible with construction methods and site conditions. Monitor effectiveness of the installed system and its effect on adjacent property.

B. Intercept water flowing into excavations and divert it to sumps or ditches to allow pumping of collected water out of the excavation.

C. Provide settling basins, geotextile containment devices or other sediment removal and water treatment devices for water quality control and compliance with regulatory and permit requirements.

1. Install geotextile containment devices in accordance with the manufacturer's instructions and requirements.

D. Operate and maintain groundwater control systems in accordance with the Groundwater Control Plan. Notify Engineer in writing of any changes made to accommodate field conditions and changes to the Work.

E. Provide for continuous system operation, including nights, weekends, and holidays. When deemed appropriate, provide backup power source for electrical service.

F. Monitor operations to verify that the system lowers groundwater levels at a rate required to maintain a dry excavation resulting in a stable subgrade for prosecution of subsequent operations.

G. Remove all groundwater control systems upon completion of construction or when dewatering and control of surface or groundwater is no longer required. Remove and grout piezometers when groundwater control operations are complete.

3.06 WELL ABANDONMENT

A. Abandon wells using a licensed water well contractor in accordance with OAR 690-220.

B. Include well abandonment costs, including permits and documentation, in the Lump Sum Price.

3.07 RECORDS

A. Provide a daily record of the average flow rate. Provide results of water quality testing as required by the Permit for discharge.

B. Observe and record the elevation of the groundwater during the period that the dewatering system is in operation.

END OF SECTION

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SECTION 31 23 23.33

CONTROLLED LOW STRENGTH MATERIAL

PART 1 - **GENERAL**

1.01 SECTION INCLUDES

A. Requirements for controlled low strength material (CLSM) as backfill material in specific locations.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01 33 00 – Submittals

1.03 DEFINITION

A. Controlled low strength material (CLSM): A highly flowable, lean concrete mix consisting of a mixture of cement, fly ash, densely graded mineral aggregates, water and admixtures. Characteristics include:

1. Capable of freely flowing to fill excavations and voids without compaction or other additional effort.

2. Used in trenches and for backfill adjacent to structures where clearance is limited, and in other areas specifically identified on the Drawings or specified.

3. Low permeability to prevent migration of adjacent fines into the set mix.

4. Easily excavated after curing with minimum risk of damage to buried utility.

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Mix Design: Identify name and/or number of the mix design and proposed use. Provide the proportions and gradations of materials proposed for CLSM.

C. Certified test results for compressive strength.

1.05 QUALITY ASSURANCE

A. Demonstrate that the CLSM mix meets the specified requirements, including compressive strength.

B. Enlist the services of a testing laboratory to prepare test cylinders and to transport cylinders to the laboratory for testing.

C. Testing expenses shall be borne by the Contractor.

D. Test Cylinders

1. Procedure: Make 6-inch diameter by 12-inch high test cylinders in accordance with ASTMD4832.

2. Required Number: Not less than 3 cylinders for each 200 cubic yards of CLSM placed, with a minimum of 3 cylinders for each location where CLSM is used.

3. Test two cylinders at 28 days, third cylinder is spare.

E. Field Testing:

1. Test flow consistency per ASTM D6103.

2. Test flow consistency once every 200 cubic yards of CLSM placed.

PART 2 - **PRODUCTS**

2.01 GENERAL

A. CLSM Mix: A mixture of Portland cement, fly ash, aggregate, water, and admixtures that produce a material of controlled density and of low compressive strength capable of filling all spaces between the pipe, the bedding and the trench walls.

2.02 MATERIALS

A. Cement: Conforming to ASTM C150, Type II or III with total alkali content not more than 0.8 percent.

B. Water: Clean, potable water.

C. Fly Ash

1. Mix Designs used for Pipe Bedding and Trench Backfill: Class F in conformance with ASTM C618.

2. Mix Designs used for Backfill of Excavations: Class F in conformance with ASTM C618.

D. Aggregate Materials

1. Densely graded rock conforming to the following gradation:

Sieve Size	Percentage Passing
1”	100
No. 8	50-100
No. 200	0-5

2.03 DESIGN REQUIREMENTS

A. Water-cement Ratio: Not to exceed 3.5.

B. Minimum Cement Content: 50 pounds per cubic yard.

C. Use fly ash to improve flow-ability of the fresh CLSM and to regulate the strength. Do not use more than 300 pounds per cubic yard.

D. Unit Weight Requirements

1. Density of CLSM when used as backfill of excavations: Between 100 pounds per cubic foot and 130 pounds per cubic foot in the as-placed condition as determined by ASTM D6023.

E. Compressive Strength Requirements

1. Mix Designs used for Pipe Bedding and Trench Backfill: Compressive strength at 28 days between 100 psi and 150 psi as determined in accordance with ASTM D4832.

2. Mix Designs used for Backfill of Excavations: Compressive strength at 28 days between 150 and 300 psi as determined in accordance with ASTM C4832.

3. Mix Designs used for Excavation Support and Protection: Compressive strength at 28 days 1,500 psi or greater.

2.04 CONSISTENCY AND MIXING

A. Consistency: Similar to that of a thick liquid so that it flows readily and fills spaces and voids around pipes and structures.

B. Slump: Between 6 inches and 8 inches when tested in accordance with ASTM C143.

C. Uniform consistency and appearance.

D. Mixing Method and Time: As required to produce a uniform mixture of cement, fly ash, aggregate, admixtures, and water.

2.05 MEASUREMENT OF MATERIALS

A. Use weighing equipment to determine the amount of cement, fly ash, and aggregate entering into each batch. Where batches are proportioned to contain an integral number of conventional sacks of cement, and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 lbs.

B. Use a suitable water meter or other acceptable method of measuring the quantity of water entering the mixer.

PART 3 - **EXECUTION**

3.01 PLACEMENT

A. Thoroughly settle and consolidate CLSM as the material is placed in excavations. Fill the entire depth of the layer that is being consolidated, into a dense, homogeneous mass, filling all spaces and voids and bringing only a slight excess of water to the exposed surface. Place and consolidate CLSM by means that will not cause segregation of the mix.

B. Do not place CLSM under the following conditions:

1. When the air temperature is below 40 degrees Fahrenheit.

2. When the excavation contains water or when the bottom or walls of the excavation are frozen or contain frozen material.

C. Prevent flotation of pipes by placing CLSM in two or more lifts, with each lift reaching an initial set before the succeeding lift is placed. Correct any flotation and displacement of pipelines.

D. Placement of CLSM in Excavations: Limit lift thickness to 10 feet, place subsequent lifts after CLSM has achieved the minimum specified compressive strength.

3.02 PROTECTION OF CLSM

A. Protect CLSM from equipment, traffic and backfilling operations until the surface has achieved an initial set and has hardened enough to develop a minimum penetration number of 650 when tested in accordance with ASTM C403.

B. If the trench backfill is not to be placed over the CLSM within eight hours after CLSM placement, place a 6-inch layer of moist backfill over the CLSM.

END OF SECTION

SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Temporary excavation support systems.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 31 23 23.33– Controlled Low Strength Material
3. Section 31 00 00 – Earthwork
4. Section 03 60 00 – Grout

1.03 DEFINITIONS

A. Protection Systems:

1. Sloping or benching systems for excavated slopes.
2. Structural support systems, shield systems, and other systems for preventing excavation wall failure.

1.04 SUBMITTALS

A. Prepare and submit in accordance with Section 01 33 00.

B. Submit information as a complete package. Include all items required by the Contract Documents. Incomplete submittals will not be reviewed and will be returned for resubmittal as a complete package.

C. Shop Drawings

1. Prepared, signed, and sealed by a professional engineer who is registered to practice in the state of Oregon.
2. Clearly indicate structural sections of shoring members, welding details, bolting details, and bracing details.
3. Indicate existing and new structures, pipelines and other improvements located in the vicinity and impacting the design of the shoring system.
4. Provide details for bracing, reinforcement and sealing around penetrations.

D. Calculations: Structural calculations verifying and demonstrating the structural safety and adequacy of the sheeting, shoring, and bracing to be used.

1. Prepared, signed, and sealed by a registered Professional Civil or Structural Engineer who is registered to practice in the State of Oregon.

2. Provide calculations for the different load, support and other conditions that occur during the sequence of installation, construction of facilities protected by the shoring and the sequence of removal of the internal bracing and shoring.

E. Sheet Pile Driving Equipment: Information on type of equipment to be used, including manufacturer, model number and driving energy.

F. Qualifications of registered Professional Engineer and shoring installer, including project references.

G. Prepare a detailed plan illustrating the sequence of installation and removal of shoring systems and internal bracing. Include sketches showing the various stages in the sequence.

H. Letter confirming installation of the shoring system is in accordance with the shoring design.

I. Control Points and Stability Measurements:

1. Submit proposed location and details of control points and method and schedule for obtaining stability measurements.

2. Submit field notes documenting stability measurements.

1.05 INSTALLER QUALIFICATIONS

A. Shoring installer must have a minimum of five successful past installations of shoring systems of comparable overall heights and comparable penetration of soils similar to those found on the project site.

1.06 PERFORMANCE REQUIREMENTS

A. Design and install excavation support and protection systems that are capable of:

1. Supporting excavation sidewalls and bottom to maintain the required excavation or trench section.

2. Resisting soil and hydrostatic pressure and superimposed construction loads and other live loads.

3. Protecting existing facilities in the vicinity of the excavation from damage due to settlement or movement of soil

B. Provide professional engineering services necessary to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer registered in the State of Oregon.

C. Install and remove excavation support and protection systems without damaging existing buildings, pavements, utilities, railroad facilities and other improvements adjacent to excavation.

D. Excavations

1. Protect workers from hazard of caving ground and other hazards.

2. Install excavation protection system in locations where:

a. Protection system is specifically indicated on the Drawings.

b. Excavations are equal to, or greater than, 5 feet deep.

c. Excavations are less than 5 feet deep, but there is a potential for cave-in.

d. When engineering analyses prepared by the Contractor indicate the stability of existing structures and facilities may be jeopardized by settlement or movement of soil.

1.07 GENERAL DESIGN REQUIREMENTS

A. Design excavation support systems to meet requirements and standards of the Occupational Safety and Health Administration (OSHA).

B. Design excavation support systems to meet the requirements of Oregon Administrative Rules, Chapter 437, Division 3, Subdivision P.

C. Design structural steel members in accordance with the American Institute of Steel Construction (AISC) Manual of Steel Construction Allowable Stress Design and the Uniform Building Code.

D. Excavation support systems for trench excavations shall be selected by the Contractor based on the soil and rock conditions, depths of trench excavations, groundwater conditions and other site conditions. No attempt has been made by Engineer to define acceptable trench shoring options.

E. Excavation support systems for structural excavations may consist of either driven steel sheet piling or drilled and/or driven soldier beam and lagging systems complying with requirements of this Section. Contractor may select from either specified system.

F. Allowable Deflection: Not more than 1/2-inch at any point on the shoring system.

G. Cantilevered Design Limits:

1. Maximum height of cantilevered shoring above the bottom of the excavation shall not exceed 15 feet.

H. Resistance to Overturning

1. Design soldier piles and sheet piles with sufficient depth below the excavation to:

a. Resist lateral movement or overturning of the pile, and

b. Act as an effective water cutoff to prevent heaving or flow of soil into the excavation.

2. Calculate the required depth of pile below the bottom of the excavation by assuming the soil immediately below the bottom of excavation does not provide passive resistance for a depth of 1.5 times the effective pile diameter.

1.08 DESIGN REQUIREMENTS FOR SOLDIER PILES AND LAGGING

A. Design soldier piles for downward loads including vertical loads from tie back anchors.

B. Flexural Strength of Lagging: In accordance with the Uniform Building Code, but not greater than 1,500 psi.

C. Wales: Use back-to-back structural members.

D. Soil Anchors, Rock Anchors and Deadmen Anchors:

1. Design tie back anchors with a safety factor of not less than 2 times the calculated load from the shoring.

2. When calculating the length of soil anchors needed to resist the load from the shoring, do not include any anchor length within the potential active pressure soil failure zone behind the face of the shoring.

3. Design anchor tie rods for 130 percent of the calculated load from the shoring.

4. When tie rod couplings are used, design anchor tie rods for 150 percent of the calculated load from the shoring.

1.09 GEOTECHNICAL DATA REPORT (GDR)

A. A geotechnical data report has been prepared for this Project and is included with specifications as a supplement for information only. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for design of the excavation support systems.

2. Copies of the GDR are bound separately and are included in the Contract Documents.

1.10 GEOTECHNICAL ENGINEERING REPORT

A. A Geotechnical Engineering Report has also been prepared and it is available if requested. The geotechnical engineering report is not considered part of the Contract Documents.

1.11 PROJECT SPECIFIC DESIGN REQUIREMENTS

A. Design of Excavation Support System

1. Design Groundwater Elevation: Two feet below ground surface elevation.

2. For excavations extending into basalt bedrock the rock can be cut at slopes as steep as vertical.

3. Specialized drilling equipment may be required to pre-drill holes for soldier pile installation within bedrock.

4. Excavation support systems may be required to protect utilities and provide space for access to the site.

1.12 JOB SITE POSTINGS

A. Maintain at least one copy of the protection system design at the job site while the excavation is open in accordance with the requirements of Oregon Administrative Rules, Chapter 437, Division 3, Subdivision P.

1.13 SEQUENCE AND SCHEDULING

A. Do not begin excavations or installation of excavation supports until submittals for excavation support systems have been accepted by the Engineer and until materials necessary for installation are on site.

B. Allow a minimum of 30 calendar days for Engineer's review of submittals for excavation support systems.

C. Do not begin excavations or installation of excavation support systems until initial survey measurements on control points on existing structures and other improvements are obtained to document baseline elevations and locations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel Soldier Beams: ASTM A36, ASTM A690 or ASTM A992.

C. Steel Sheet Piling: ASTM A328, ASTM A572 or ASTM A690; with continuous interlocks.

D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness as determined by design calculations, but not less than 3 inches.

E. Lean Concrete Mix:

1. Controlled Low Strength Material in accordance with Section 31 23 23.33.

2. A mixture of sand, fine aggregate, water and 2 sacks of cement per cubic yard to create a flowable mixture that fills voids.

3. Minimum Compressive Strength: 1500 psi.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to beginning installation of the excavation support system, pothole to locate existing buried utilities in the vicinity of the excavation. Survey utilities and compare actual locations to those locations indicated on the Drawings and the Shop Drawings. Determine any areas of conflict and revise the design and layout of the excavation support system to eliminate these conflicts.

3.02 SLOPING AND BENCHING OF EXCAVATED FACES

A. Where structural excavation support systems are not specifically indicated on the Drawings, sloping and benching systems for exposed faces of excavations may be utilized.

B. Construct sloping and benching systems in accordance with Section 31 00 00.

3.03 TRENCHING SUPPORT SYSTEMS

A. Where structural excavation support systems are not specifically indicated on the Drawings, trench support systems consisting of hydraulic jacks and plates, trench shield systems, and other trench protection systems may be utilized.

3.04 SOLDIER BEAMS AND LAGGING

A. Before starting excavation, drive steel soldier beams or install steel soldier beams in pre-drilled holes.

1. Installation of Soldier Beams in Pre-Drilled Holes

a. Diameter of pre-drilled hole: Not to exceed the outside dimensions of the soldier beam.

b. Backfill around soldier beam using a lean concrete mix.

B. Space soldier beams at regular intervals not to exceed allowable flexural strength of the wood lagging. Align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging.

D. Install horizontal wales at locations indicated on the shop drawings and secure to soldier beams.

E. Fill voids behind lagging with gravel, lean concrete, or other material acceptable to the Engineer.

3.05 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.06 BRACING

A. Locate bracing to clear temporary and permanent work and to allow lowering of material and equipment into the excavation.

B. If necessary to move brace, install new bracing before removing original brace.

C. Install internal bracing when calculations indicate bracing is required to prevent spreading or distortion of braced frames.

D. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.07 INSPECTION

A. Designer of the shoring system is responsible for confirming proper installation of the shoring system. Shoring system designer, or a representative of the designer, shall make site visits to confirm installation is in accordance with the accepted shoring design.

B. Submit letter of proper installation confirming installation is in accordance with the shoring design.

C. Remove at least the top 10 feet of excavation support systems.

D. Remove excavation support and protection systems when backfill can support the remaining open excavation and bear soil and hydrostatic pressures. Remove support and protection systems in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.

E. After removal, promptly fill voids resulting from the extraction of shoring with sand-cement grout conforming to the requirements of Section 03 60 00. Repair or replace adjacent work damaged or displaced by excavation support and protection systems removal.

END OF SECTION

SECTION 32 01 16

PAVEMENT RESTORATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The restoration of asphalt and concrete pavements and surfaces, including roadways, driveways, road shoulders, medians, traffic signal loops, pavement markings, curbs, gutters, sidewalks, and any other surfaces that may be damaged as a result of the work.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittals
2. Section 32 11 23– Aggregate Base Course

1.03 REFERENCES

A. Standard Specifications:

1. Where the term “Standard Specifications” is used, such reference shall mean the current edition of the Oregon Department of Transportation Standard Specifications for Highway Construction.
2. Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications.
3. In case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

1.04 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00.

B. Submit information for materials to be used in restoring surfaces including mix designs, aggregates, asphalt, pavement fabrics, liquid priming asphalt, surface sealers, roadway striping products, and all other materials to be used for surface restoration.

1.05 DEFINITIONS

A. Surface Restoration: The repair or replacement of surface materials back to pre-construction condition or better or as indicated due to the work or damaged as a result of the work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aggregate base and sub-base materials:

1. As defined in Section 32 11 23, unless otherwise indicated.

B. Hot Mix Asphalt Concrete (HMAC) Pavement:

1. Level 2 ACP, 1/2” dense, conforming to Section 00744 of the Standard Specifications, modified by this Section.

C. Prime coat:

1. Conforming to Section 00700 of the Standard Specifications.

D. Tack coat:

1. Conforming to Section 00730 of the Standard Specifications.

E. Traffic Stripes and Pavement Markers:

1. Conforming to the 2018 Standard Specifications for Construction.

2. Thermoplastic alkyd-type for extrusion application producing an adherent reflectorized stripe capable of resisting deformation by traffic.

F. Concrete:

1. Conforming to Section 02015 of the. Standard Specifications.

PART 3 - EXECUTION

3.01 GENERAL

A. Reconstruct surfaces to pre-construction condition or better unless otherwise indicated, including curbs, gutters, sidewalks, driveways, road shoulders, medians, pavement, ditches, drainage ways, and related items that have been temporarily removed, damaged, or displaced as part of the work.

B. Reconstruct pavements in conformance with the 2018 Standard Specifications for Construction, as modified herein.

3.02 SAWCUTTING

A. Sawcut existing pavement surfaces prior to surface restoration.

B. Sawcut in straight lines parallel or perpendicular to existing roadway centerlines a minimum of 12 inches outside the edge of trench unless otherwise indicated.

C. Where sections of existing pavement remain that are less than 2 feet wide between the proposed sawcut and an existing edge of asphalt concrete, curb, or gutter, remove the existing remaining pavement and replace it as part of the pavement restoration.

D. Where pavement is damaged outside of sawcut lines, re-cut lines and remove damaged pavement.

E. Where voids develop under existing pavement to remain, re-cut lines, remove pavement and fill voids.

3.03 ASPHALT CONCRETE PAVEMENT SURFACE RESTORATION

A. Place asphalt concrete in accordance with the following as modified herein:

1. Prepare the road subgrade as specified in the Standard Specifications for Construction.

2. Immediately after the asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and

uniformly compacted by rolling until it is compacted to at least 90% of max density. Max density of the mixture shall be determined in conformance with AASHTO T -209. The surface of each layer and of each course shall be rolled when the temperature of the mixture is above 185-degrees Fahrenheit.

3. Test asphalt concrete per:

a. Section 00744.49 of the . Standard Specifications.

3.04 CONCRETE PAVEMENT SURFACE RESTORATION (NOT USED)

3.05 RESTORATION OF PRIVATE ROADS, PARKING AREAS, AND OTHER PRIVATE IMPROVED AREAS

A. Reconstruct finished surfaces of private roads, parking areas, and other improved areas with the same materials and to not less than the pre-construction dimensions, unless otherwise indicated.

B. Reconstruct improvements damaged as part of the work to pre-construction condition or better.

C. Asphalt Pavement: Match existing pavement thickness, or at least 3 inches of asphalt concrete, whichever is greater.

D. Gravel, stone, or aggregate surfaces: Match existing thickness, or at least 6 inches, whichever is greater.

3.06 RESTORATION OF CONCRETE SURFACES

A. Reconstruct concrete surfaces including curbs, gutter, sidewalks, wheelchair ramps, medians, valley gutters and any other concrete surface or structure temporarily removed, damaged, or displaced as part of the work in accordance with:

1. Section 00759 of the 2018 Standard Specifications for Construction.

3.07 SEALCCOAT (NOT USED)

3.08 TRAFFIC STRIPES AND PAVEMENT MARKINGS

A. Replace traffic stripes and pavement markings in conformance with the following as modified below:

1. 2018 Standard Specifications for Construction.

2. Contractor to coordinate with Owner to determine if Local Standard Specification is available. If one is available, it will take precedence over the Standard Specifications.

B. Restore traffic stripes and pavement markings in accordance with the following schedule.

1. Place cat tracking for the remaining striping the day following installation of the surface course.

2. Place traffic striping and markings not more than one day following approval of the cat tracking by the roadway jurisdiction.

3. Place pavement markings not more than 2 weeks following installation of the pavement.

C. Application:

1. Apply thermoplastic material by extrusion method in a single, uniform layer.
2. Use stencils in new condition without bends or damage when applying pavement markings.
3. Completely coat the pavement surface and fill all surface voids with the marking material.
4. Apply glass beads promptly to the molten thermoplastic material.
5. Rates of application
   a. Stripes: 0.075-inch thick, ± 0.005 inch.
   b. Pavement markings: 0.125-inch thick, ± 0.005 inch
   c. Glass beads: 8 pounds per 100 square feet.

3.09 PAVEMENT MARKERS

A. Restore pavement markers in accordance with:

1. 2018 Standard Specifications for Construction.
2. Contractor to coordinate with Owner to determine if Local Standard Specification is available. If one is available, it will take precedence over the Standard Specifications.

3.10 TRAFFIC SIGNAL LOOPS (NOT USED)

3.11 RAISING MANHOLE, VALVE, AND OTHER UTILITY COVERS (NOT USED)

END OF SECTION

SECTION 32 01 17

COLD PLANE PAVEMENT REMOVAL

PART 1 - GENERAL

1.01 SCOPE

A. This Section includes the grinding of existing Portland cement and asphaltic concrete pavement.

B. Section Includes:

1. Concrete pavement removal equipment.

2. Concrete pavement removal.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 32 01 20 – Reconditioning Existing Roadway Reference Standards

1.03 REFERENCED STANDARDS

A. Standard Specifications:

1. Where the term “Standard Specifications” is used, such reference shall mean the current edition of the Oregon Department of Transportation Standard Specifications for Highway Construction.

2. Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications.

3. In case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

PART 2 - MATERIALS

2.01 EQUIPMENT

A. Planing machine or grinder.

1. Self-propelled.

2. Capable of accurately establishing profile grades within a tolerance of 0.02-foot by reference from either the existing pavement or from independent grade control.

3. Possess a positive means for controlling cross slope and elevations.

4. The equipment shall incorporate a totally enclosed cutting drum with replaceable cutting teeth and shall have an effective means for removing excess material from the surface and for preventing dust from escaping into the air.

B. The use of a heating device to soften the pavement will not be permitted.

PART 3 - EXECUTION

3.01 PAVEMENT REMOVAL

A. Work Limits:

1. The existing pavement shall be removed to the depth, width, grade and cross section shown on the Drawings or as directed by the Engineer to provide a surface profile true to specified grade and transverse slope.

B. Scheduling:

1. Except where samples are taken to establish a job mix formula, the existing surfacing shall not be removed more than 24 hours prior to construction of the new surfacing, unless otherwise approved by the Engineer.

2. Where permits obtained for the project dictate scheduling of existing pavement removal and construction of new surfacing and vary from the requirements of this Section, the stricter of the conditions shall apply.

C. Procedures for conducting cold plane removal of material shall conform to the requirements and specifications set forth in the Section 00620, Cold Plane Pavement Removal, of the Standard Specifications.

3.02 RECONDITIONING EXISTING ROADWAY

A. The reconditioning and preparing of existing roadway subgrades, aggregate bases, surfacings and pavements shall be completed in accordance with Section 32 01 20.

3.03 DISPOSAL OF MATERIALS

A. Materials removed under this Section which are not recycled and used on the project shall become the property of the Contractor at the point of removal and shall be disposed of off the limits of the project in a manner satisfactory to the Owner.

END OF SECTION

SECTION 32 01 20

RECONDITIONING EXISTING ROADWAY

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Reconditioning and preparing of existing roadway subgrades, aggregate bases, surfacings and pavements on which an additional layer or course of material is to be placed. Work under this Section includes existing roadway shoulders, cut ditches, road connections, approach roads, and other roadbed areas on which construction work is to be performed

B. Section Includes:

Removal and replacement of unsuitable materials.

Reconditioning and preparing of existing roadway subgrades, aggregate bases, surfacings and pavements.

1.02 REFERENCE STANDARDS

A. Standard Specifications:

Where the term “Standard Specifications” is used, such reference shall mean the current edition of the Oregon Department of Transportation Standard Specifications for Highway Construction.

Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications.

In case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

PART 2 - MATERIALS

2.01 MATERIALS

A. Provide materials and quality control in accordance with Section 00610, Reconditioning Existing Roadways, of the Standard Specifications.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Comply with the requirements of Section 00610, Reconditioning Existing Roadways, of the Standard Specifications.

END OF SECTION

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SECTION 32 11 23

AGGREGATE BASE COURSE MATERIAL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aggregate base course material and placement.

1.02 DEFINITIONS

A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.

B. Completed Lift: Compacted with uniform surface reasonably true to cross-section.

1.03 STANDARD SPECIFICATION

A. Oregon Standard Specifications for Construction (OSSC), 2021 edition.

1.04 SUBMITTALS

A. Product Data: Source, gradation, and testing data records for aggregate base course material previously produced by the supplier, which demonstrates compliance with the specified gradation and physical requirements.

1.05 DELIVERY, STORAGE AND HANDLING

A. Storage and Protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

1.06 QUALITY ASSURANCE

A. Material and Compaction Testing

1. Source Testing of Materials: Provided and paid for by the Contractor

2. Field Testing for Compaction: Provided and paid for by the Owner

B. Compaction Testing

1. In-place Density: Density of aggregate base course material that has been placed and compacted in the field, then tested in conformance with ASTM D6938 to determine density relative to the maximum density.

2. Maximum Density: Density obtained in the laboratory when tested in accordance with ASTM D1557.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aggregate: Clean, hard, durable particles consisting of the any combination of the following:

1. Crushed Rock

2. Sand

B. Use either 1-1/2-inch or 3/4-inch aggregate grading unless otherwise indicated. Do not change grading without authorization from the Engineer.

C. Conform to the following gradation when tested in accordance with AASHTO T 27:

Sieve Sizes (Square Openings)	Percent by Weight Passing Sieve 3/4" Maximum	Percent by Weight Passing Sieve 1-1/2" Maximum
2"	-	100
1-1/2"	-	95-100
1-inch	100	-
3/4-inch	90-100	55-75
1/2"	-	-
3/8"	55-75	-
1/4"	40-60	35-50
No. 10	(1)	(1)
(1) Of the fraction passing the 1/4 inch sieve, 40% to 60% shall pass the No. 10 sieve.		

A. Conform to the following fracture of rounded rock when tested in accordance with AASHTO T 335:

Minimum Percent of Fractured Particles (by Weight of Material)	
Designated Size	Retained on ¼ inch Sieve
1 ½"–0 and larger	50
Smaller than 1 ½"-0	70

B. Conform to the following durability requirements:

Test	Test Method	Requirements
Abrasion	AASHTO T 96	35% maximum
Degradation	ODOT TM 208	30% maximum
Sediment Height	ODOT TM 208	3.0" maximum

C. Sand Equivalent (AASHTO T 176): 30 minimum.

PART 3 - EXECUTION

3.01 PLACEMENT

A. Obtain Engineer's acceptance of subgrade before placement of base course.

B. Do not place aggregate base material on soft, muddy or frozen subgrade.

C. Moisture condition, spread and compact aggregate base course material to the lines, grades and dimensions indicated on the Drawings and in accordance with applicable sections of OSSC Section 00641.

1. Do not haul material over surfacing in process of construction.

2. Spread and distribute material to provide the required density, depth, grade and dimensions with allowance for subsequent lifts.

3. Produce an even distribution of material without segregation. Should segregation occur, modify or change the spreading procedure to correct segregation problems and to result in uniformity in grading.

3.02 COMPACTION REQUIREMENTS

A. Compact aggregate base course material to obtain an In-Place Density of 95 percent of maximum density unless otherwise indicated.

B. Commence compaction effort by starting at the outer edges of the layer and continue toward the center.

C. Apply water as needed to obtain required In-Place Density.

D. Place and compact each lift to required density before succeeding lift is placed.

E. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

3.03 TOLERANCES

A. Structure subgrade: Plus or minus 0.05-foot of the design elevation.

B. Pavement subgrade: Plus or minus 0.05-foot of the design elevation.

C. Aggregate Base surface grade: Plus or minus 0.05-foot of the design elevation.

3.04 FIELD QUALITY CONTROL

A. Contractor's compaction testing responsibilities:

1. Accomplish specified degree of compaction.

2. Undertake and control compaction effort by confirmation tests to verify that the compaction work complies with the specified degree of compaction.

3. Pay for compaction testing services and submit compaction test reports to the Engineer.

B. Frequency of Compaction Testing

1. Structures: Make one compaction test for each 50 cubic yards of aggregate base course material placed, with a minimum of one compaction test per structure.

2. Roadway and Paved Areas: Make one test every 1500 square feet of pavement.

END OF SECTION

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SECTION 32 12 16

ASPHALT CONCRETE PAVEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Construction of asphalt concrete pavement.

1.02 REFERENCE STANDARDS

A. References herein to "AASHTO" shall mean Association of American State Highway Transportation Officials.

B. Standard Specifications:

1. Where the term "Standard Specifications" is used, such reference shall mean the current edition of the Oregon Department of Transportation Standard Specifications for Highway Construction.

2. Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications.

3. In case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

1.03 DEFINITIONS

A. Maximum Density Test (MDT): Theoretical maximum density of the bituminous mixture determined by multiplying the theoretical maximum specific gravity, determined by ASTM D2041 (Rice), by 62.4 pounds per cubic foot.

1.04 SUBMITTALS

A. Aggregate Qualification Tests: In accordance with Standard Specifications Section 00640 for aggregate used in aggregate base.

B. Aggregate Qualification Tests: In accordance with Standard Specifications Section 00745 for aggregate used in asphalt concrete.

C. Job mix formula shall be an approved job mix formula. Submit formula, supplier, and product identification to the Engineer 30 days prior to start.

1. Definite percentage for:

a. Each sieve fraction.

b. New asphalt cement.

c. Recycled asphalt pavement.

2. Temperature of completed mix when discharged from mixer.

3. Character and quantity of anti-strip and recycling agents.

1.05 QUALITY ASSURANCE

A. Testing to determine compliance with the specifications shall be performed by an independent testing laboratory contracted by the Contractor and approved by the Engineer. Testing costs shall be borne by the Contractor.

B. A minimum of five nuclear densometer readings shall be taken in random locations within every test area. Each test area shall not exceed 200 tons of asphalt; however, smaller areas may be designated by the Engineer.

C. The surface smoothness of the new asphalt concrete pavement shall be such that when a 10-foot straightedge is laid longitudinally across the paved area in any direction, the new pavement shall not deviate from the straightedge more than 1/8-inch. Surface drainage shall be maintained. Additionally, paving must conform to the design grade and crown and contain no abrupt edges, low or high areas or any other imperfections as determined by the Engineer. Pavement construction not meeting these requirements will be repaired by grinding the existing pavement to a 1-1/2-inch depth and replacing with Level 3, 1/2-inch dense graded Hot Mix Asphalt Concrete (HMAC) the full width at no cost to Owner.

1.06 PRE-PAVING CONFERENCE

A. Any supervisory personnel of the Contractor and any subcontractors who are to be involved in the paving work shall meet with the Engineer, at a time mutually agreed upon, to discuss methods of accomplishing all phases of the paving work.

B. The Contractor shall be prepared to review the size and type of equipment to be used and the anticipated rate of placement to determine equipment needs.

PART 2 - PRODUCTS

2.01 AGGREGATE MATERIAL

A. Aggregate Base for Dense Graded Asphalt Concrete: The aggregate material shall be a clean, well-graded crushed base aggregate conforming to the Standard Specifications. Base course shall be 3/4-inch minus aggregate as shown on the Drawings or as otherwise approved during construction.

2.02 ASPHALT CONCRETE PAVEMENT

A. Dense Graded HMAC:

1. Use Level 3, 1/2-inch-dense graded, PG 64-22 HMAC. Conform to the requirements as specified in Section 00745 of the Standard Specifications. Conform to the requirements as specified in Section 00745 of the Standard Specification.

2. Asphaltic concrete pavement delivered to the site shall be accompanied by a ticket with the approved "job mix formula" number shown. Loads without tickets identifying the job mix formula will not be accepted.

3. Percent of recycled asphalt pavement used in new asphalt pavement shall not exceed 30 percent. Recycled asphalt pavement may not be used in top wearing course unless otherwise approved by the Engineer.

B. Tack Coat

In accordance with Standard Specifications. Use AR 4000, AC-20 asphalt or CSS-1 emulsified asphalt C.

C. Seal and Cover Coat

Asphalt material shall be CRS-2 cationic emulsified asphalt. Cover stone shall conform to size 1/4-inch #10 aggregate in the Standard Specifications.

D. Subgrade Geotextile

1. For subgrade separation using dense graded asphalt concrete, use subgrade geotextile with Certification Level B as specified in Section 02320 of the Standard Specifications.

E. Subgrade Stabilization

In the event that unstable materials are encountered during excavation, the additional excavation and installation of geotextile fabric and 12 inches of rock substructure will be required, as directed. Conform to the requirements as specified in Section 00331 of the Standard Specifications. For subgrade separation, use subgrade geotextile with Certification Level B as specified in Section 02320 of the Standard Specifications.

PART 3 - EXECUTION

3.01 AGGREGATE PAVEMENT BASE

A. Place pavement base to the depth shown on the plans or as specified in all cases, pavement base shall be compacted to a minimum depth of 6 inches. Bring the top of the pavement base to a smooth, even grade at a distance below finished grade equivalent to the required pavement depth.

B. Compact the pavement base with mechanical vibratory or impact tampers to a density of not less than 95 percent of the maximum density, as determined by AASHTO T-99.

C. Obtain the Engineer's acceptance of the subgrade before beginning construction of the aggregate base course.

D. When, in the judgment of the Engineer, the weather is such that satisfactory results cannot be secured, suspend operations. Place no aggregate base course in snow or in soft, muddy, or frozen subgrade.

E. If the required compacted depth of aggregate base course exceeds 6 inches, construct in two or more lifts of approximately equal thickness. Maximum compacted thickness of any one lift shall not exceed 6 inches. Compact each layer to the specified density before a succeeding lift is placed.

3.02 ASPHALT CONCRETE PAVEMENT

A. Construct asphalt concrete pavement in accordance with Section 00745 of the Standard Specifications.

B. Conform to the requirements for prime coat and tack coat in the Standard Specifications. Tack coat all edges of existing pavement, manhole and clean out frames, inlet boxes, and

like items. When rate is not specified, asphalt will be applied at the rate of 0.1-gallon per square yard.

C. Obtain the Engineer's acceptance of the aggregate base course before beginning construction of the asphalt concrete wearing course.

D. Hot mix asphalt shall be placed on dry, prepared surfaces, when air temperature in the shade of 40 degrees Fahrenheit (F) or warmer, unless otherwise authorized by the Engineer.

E. Placing asphalt pavement during rain or other adverse weather conditions will not be permitted unless otherwise authorized by the Engineer, except that asphalt mix in transit at the time these adverse conditions occur may be placed provided it is of proper temperature, the mix has been covered during transit, and it is placed on a foundation free from mud or free-standing water.

F. Correct any defects in material and workmanship, as directed, when determined detrimental by the Engineer. These include segregation of materials, non-uniform texture, and fouled surfaces preventing full bond between successive spreads of mixture. The corrections or replacement of defective material or workmanship shall be at the Contractor's expense.

G. Compact the bituminous mixture to at least 92 percent of the Theoretical Maximum Density.

H. The finished surface of each course of layer of mixture shall be of uniform texture, smooth, and free of defects and shall closely parallel that specified for the top surface finished grade. Remove and replace boils and slicks immediately with suitable materials.

I. The surface of each layer when tested with a Contractor-furnished 10-foot straightedge shall not vary from the testing edge by more than 0.02-foot for underlying courses of pavements and 0.015-foot for finished top courses or wearing courses of pavements. At no point shall the finished top of the wearing course vary more than 0.03-foot from the specified finished grade.

J. Lift thickness shall be as shown on the drawings or specified, but not to exceed 3 inches.

K. Do not place asphalt concrete pavement on emulsified asphalt (tack coat) until the asphalt separates from the water (breaks) but before it loses its tackiness.

L. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.

3.03 FIELD QUALITY CONTROL

A. Job mix will be sampled immediately behind the paving machine.

B. Temperature of the mix will be measured immediately behind the paver.

C. The theoretical maximum specific gravity of the bituminous mixture will be determined in accordance with ASTM D2041.

D. Properties of the job mix will be measured using ASTM D2041.

E. Density of the compacted job mix will be measured in accordance with ASTM D2922.

3.04 ADJUSTMENT OF EXISTING MANHOLE COVERS AND VALVE BOXES

A. Prior to placing asphalt concrete pavement, the CONTRACTOR shall make all necessary adjustments to existing manhole frames and covers and valve box covers to ensure that the tops of the manhole covers or valve box lids are flush with the finished grade of the adjoining pavement or ground surface, and that valve boxes and PVC pipes are centered and plumb over operating nut valve.

END OF SECTION

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SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Chain link fences and gates.

1.02 SUBMITTALS

A. Product Data: Submit construction details, material descriptions, gate hardware, and other data completely describing products.

B. Shop Drawings: Submit drawings showing fence and gate details. Include gate elevation drawings, post anchorage details, bracing details, extension arms, and accessories

1.03 REFERENCE SPECIFICATIONS

A. Furnish chain link gate and materials in compliance with Owner specifications. Where Owner specifications and this specification conflict, Owner specification take precedence.

1.04 QUALITY ASSURANCE

A. Manufacturer: Specializing in the manufacturer of chain link fence products with at least 5 years experience.

B. Fence installer: Company with demonstrated successful experience installing similar projects and products in accordance with ASTM F567 and having at least 5 years experience installing chain link fencing.

C. Tolerances: Current published edition of ASTM specifications tolerances apply.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling: Unload, store, and protect new and existing materials such that they are not damaged.

1.06 SEQUENCE AND SCHEDULING

A. Fences and Gates: May be constructed at any time after earthwork, pipe work, and structures to which fence is related have been completed, but prior to erosion control application.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel Chain Link Fabric

1. Height: As indicated
2. Mesh: 2 inches.
3. Size Wire: 9 gauge.
4. Coating:
    a. Provide coating as indicated.

b. Zinc coated Steel Fabric, ASTM A392 hot dipped galvanized before or after weaving,

1) Class 2 (2.0 oz/sf).

5. Fabric Selvage (2" mesh):

a. 72-inch and Greater: knuckle finish top and bottom.

B. Steel Pipe Fence Framework

1. Steel Pipe and Rail:

a. Schedule 40 standard weight pipe in accordance with ASTM A1088

b. Minimum 1.8 oz/sf hot dip galvanized zinc interior and exterior coating

c. Minimum steel yield strength: 30,000 psi for fence along ground.

d. Minimum steel yield strength: 50,000 psi for fence along retaining wall.

2. Line Posts:

a. 2.375-inch outside diameter, 3.65 pounds per linear foot for fence along ground.

b. 3.5-inch outside diameter, 7.58 pounds per linear foot for fence along retaining wall.

3. End, Corner, Pull post:

a. 2.875-inch outside diameter, 5.79 pounds per linear foot for fence along ground.

b. 3.5-inch outside diameter, 7.58 pounds per linear foot for fence along retaining wall.

4. Top, Brace, Bottom and Intermediate Rails:

a. 1.62-inch outside diameter, 2.27 pounds per linear foot

C. Tension Wire

1. Metallic Coated Steel Marcelled Tension Wire

a. 7-gauge marcelled wire complying with ASTM A824

b. Zinc Coated, ASTM A871 Class 5 (2.0 oz/sf)

c. Galvanized coil spring wire.

D. Barbed Wire

1. Metallic coated Barbed Wire:

a. Comply with ASTM A1221, Design Number 12-4-5-14R, double 12-1/2-gauge twisted strand wire with 4 point 14-gauge round barbs spaced 5 inches on center

b. Coating:

1) Zinc-coated Type Z, Class 3

2) Strand wire coating: 0.80 oz/sf,

3) Barb coating: 0.70 oz/sf

E. Fittings

1. Tension and Brace Bands: Galvanized pressed steel complying with ASTM F626, minimum steel thickness of 12 gauge, minimum width of 3/4 inch and minimum zinc coating of 1.20 oz/sf. Secure bands with 5/16inch galvanized steel carriage bolts.

2. Terminal Post Caps, Line Post Loop Tops, Rail and Brace Ends, Boulevard Clamps, Rail Sleeves: In compliance to ASTM F626, pressed steel galvanized after fabrication having a minimum zinc coating of 1.20 oz/sf.

3. Truss Rod Assembly: In compliance with ASTM F626, 3/8-inch diameter steel truss rod with a pressed steel tightener, minimum zinc coating of 1.2 oz/sf, assembly capable of withstanding a tension of 2,000 lbs.

4. Tension Bars: In compliance with ASTM F626. Galvanized steel one-piece length 2 inch less than the fabric height. Minimum zinc coating 1.2 oz. /sf.

    a. Bars for 2 inch and 1-3/4 inch mesh shall have a minimum cross section of 3/16 inch by 3/4 inch.

5. Barbed Wire Arms: In compliance with ASTM F626, pressed steel galvanized after fabrication, minimum zinc coating of 1.20 oz. /sf, capable of supporting a vertical 250 lb load.

    a. Type I – three strand 45-degree arm

F. Tie Wire and Hog Rings

1. Galvanized minimum zinc coating 1.20 oz/sf, 9-gauge steel wire in compliance with ASTM F626

G. Swing Gates

1. Galvanized steel pipe welded fabrication in compliance with ASTM F900.

2. Gate frame members 1.900-inch OD 2.72 lb/lf ASTM F1083 schedule 40 galvanized steel pipe.

3. Frame members spaced no greater than 8 feet. apart vertically and horizontally.

4. Welded joints protected by applying zinc-rich paint in accordance with ASTM Practice A780.

5. Positive locking gate latch, pressed steel galvanized after fabrication.

6. Galvanized malleable iron or heavy gauge pressed steel post and frame hinges.

7. Provide lockable drop bar and gate holdbacks with double gates.

8. Match gate fabric to that of the fence system.

9. Extend gate posts and frame members above the top of the chain link fabric at both ends of gate frame to provide support for barbed wire where barbed wire is indicated.

H. Gate Posts and Concrete Foundations for Gate Posts:

1. Gateposts per ASTM F1083 schedule 40 galvanized steel pipe.

Gate Leaf Widths, feet	Posts		Foundations	
	O.D., inches	Ounces per Lin Ft	Diameter, inches	Depth, feet
Gates with fence fabric up to and including 6 ft in height				
0 to 4	2.375	3.56	12	3
Over 4 to 10	2.875	5.79	12	4
Over 6 to 18	4.000	9.11	18	3
Gates with fence fabric over 6 ft to 12 ft in height				
0 to 6	2.875	5.79	12	4
Over 6 to 12	4.000	9.11	18	3
Over 12 to 18	6.625	18.97	18	4
Over 18 to 25	8.625	28.58	18	4.5

I. Concrete: Minimum 28-day compressive strength of 2,500 psi.

J. Fence Grounding:

1. Conductors: Bare, solid copper wire No. 6 AWG.

2. Connectors: Metal ground connectors, suitable for connecting to the ground rod and the metal fence post.

3. Ground rods: Copper clad, 5/8-inch diameter by 96-inch long.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify field conditions prior to construction.

3.02 GENERAL

A. Install chain link fence and gates as indicated on the Drawings and specified in this Section.

B. Provide fence systems that are plumb, taut, true to line and grade, and complete in all details.

C. Install fencing to generally follow finish grade of ground and provide pull posts at points where required to conform to change in grade.

D. Install fencing such that space between bottom of fence and finish grade does not exceed 1 inch.

E. Unless otherwise indicated install fence with top rail and bottom tension wire.

3.03 CLEARING FENCE LINE

A. Survey, clear, grub, grade and remove debris for installation of the fence line or required clear areas adjacent to the fence as indicated. Where no requirements are indicated, provide minimum 10 feet wide cleared and graded area centered on the fence line.

3.04 INSTALLATION

A. Posts:

1. Set posts plumb in concrete footings in accordance with ASTM F567.

2. Unless otherwise indicated:

a. Set minimum footing depth, 24 inches plus an additional 3-inch depth for each 1 foot increase in the fence height over 4 feet.

b. Minimum footing diameter four times the largest cross section of the post up to a 4.00 inches outside diameter and three times the largest cross section of post greater than a 4.00 inches outside diameter.

c. Wind load may require larger diameter or deeper footings for fence with slats.

d. Top of concrete footing to be 1 inch above grade crowned to shed water away from the post.

e. Line posts installed at intervals not exceeding 10 ft. (3.05 m) on center.

3. Finish top of concrete footings in a workmanlike manner.

B. Top Rail:

1. Install top rail in 21 foot lengths of rail continuous thru the line post or barb arm loop top.

2. Splice rail using top rail sleeves minimum 6-inches long.

3. Secure rail shall to terminal post by a brace band and rail end.

C. Bottom/Intermediate Rail:

1. Field cut and secure rail to line posts using boulevard clamps or brace band with rail end.

D. Terminal posts:

1. Brace and truss end, corner, pull and gate posts for fence 6 feet and higher and for fences 5 feet in height not having a top rail.

2. Install horizontal brace rail and diagonal truss rod in accordance with ASTM F567.

E. Tension wire:

1. Install tension wire 4 inches up from the bottom of the fabric.

2. Install tension wire 4 inches down from the top of the fabric where fence does not have a top rail.

3. Stretch tension wire taut, independently and prior to the fabric, between the terminal posts and secure to the terminal post using a brace band.

4. Secure the tension wire to each line post with a tie wire.

F. Chain Link Fabric:

1. Install fabric to outside of the framework.

2. Attach fabric to the terminal post by threading the tension bar through the fabric; secure the tension bar to the terminal post with tension bands and 5/16-inch carriage bolts spaced no greater than 12 inches on center.

3. Small mesh fabric less than 1 inch, attach to terminal post by sandwiching the mesh between the post and a vertical 2-inch-wide by 3/16-inch galvanized steel strap using carriage bolts, bolted thru the bar, mesh and post spaced 15 inches on center.

4. Stretch chain link fabric taut free of sag.

5. Secure fabric to line posts with tie wires spaced no greater than 12 inches on center and to horizontal rail spaced no greater than18 inches on center.

6. Secure fabric to the tension wire with hog rings spaced no greater than 18 inches on center.

7. Secure tie wires:

   a. Wrap tie wire around the post or rail and attach to the fabric wire picket on each side by twisting the tie wire around the fabric wire picket two full turns.

   b. Cut off excess wire and bend over to prevent injury.

G. Barbed Wire:

1. Stretch barbed wire taut between terminal posts and secure in the slots provided on the line post barb arms.

2. Attach each strand of barbed wire to the terminal post using a brace band.

H. Razor Wire

1. Install as indicated and per manufacturer's recommendations.

I. Gate Installation

1. Swing Gates:

   a. Install swing gates and gateposts in compliance with ASTM F567.

   b. Direction of swing: as indicated.

   c. Install gates plumb in the closed position having a maximum bottom clearance of 3 inches.

   d. Install gates with hinge and latch offset opening no greater than 3 inches in the closed position.

   e. Install double gate drop bar receivers in a concrete footing minimum 6 -inch diameter by 24 inch deep.

   f. Install gate leaf holdbacks for all double gates.

   g. Install electrically operated gates in compliance with ASTM F2200 and UL 325.

3.05 ADJUSTING

A. Adjust gate travel, stops, and operator position to meet field conditions.

3.06 FENCE GROUNDING

A. Install fence grounding where high-tension power lines cross fence line, fencing is within 150 feet horizontally of high-tension power lines or as indicated.

B. Grounding locations:

1. Power line crossing: At nearest fence post to crossing, nearest fence post each side of crossing at 150 feet from crossing, and at each gate within 150 feet of crossing.

2. Power line parallel: At nearest fence post to 150 foot intervals and at each gate.

C. Grounding method.

1. At each grounding location, drive ground rod vertically next to fence post until top is flush with finish grade.

2. Connect conductor to ground rod, fence post and fence fabric with metal connector.

3. Bond each gate with a flexible grounding strap.

3.07 CLEANING

A. Leave the area of the fencing neat and free of debris caused by the installation of the fence.

3.08 PROTECTION

A. Protect installed fences and gates against damage and, if damaged, repair prior to final acceptance.

END OF SECTION

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SECTION 33 13 00

DISINFECTING WATER PIPELINES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for disinfecting water pipelines prior to placing in service and includes:

1. Potable

1.02 SUBMITTALS

A. Identify methods that will be utilized to disinfect water pipelines in accordance with AWWA Standards and this Specification. Include:

1. Procedures, sample locations, type of disinfectant, and method of disposing of spent disinfectant.

B. Identify testing laboratory.

C. Submit test results.

1.03 QUALITY ASSURANCE

A. Demonstrate through analytical testing that the water pipelines are disinfected and meets requirements specified in AWWA C651.

B. Enlist the services of a testing laboratory to obtain, transport and test water samples.

1. Testing Laboratory Qualifications: Certified to perform chlorine concentration testing and bacteriological testing in accordance with AWWA standards.

C. Testing expenses: Borne by the Contractor.

PART 2 - PRODUCTS

2.01 DISINFECTANT AND DILUTION/FLUSHING WATER

A. Disinfectant: Use sodium hypochlorite solution or calcium hypochlorite granules or tablets meeting the requirements of AWWA B300. Do not utilize hypochlorite manufactured for swimming pools.

B. Dilution/Flushing Water:

1. Owner will supply potable water for Contractor's use in preparing disinfecting solution. Contractor shall convey water in disinfected pipelines or containers.

2.02 CONTRACTOR'S EQUIPMENT

A. Furnish pumps, hoses, sample connections and other equipment needed to complete disinfection process.

PART 3 - EXECUTION

3.01 GENERAL

A. Disinfect pipelines installed or modified under this Project, including:

1. Potable water, recycled water, untreated water pipelines

2. Disinfect the following:

a. Up to the point of connection with existing water system.

b. Service laterals, hydrants, and other appurtenances connected to the pipelines to be disinfected.

c. Other water facilities installed as part of the work and connected to the pipelines to be disinfected.

B. Do not connect pipelines to any other facilities until other facilities have been disinfected.

C. Avoid recontamination following disinfection. Repeat disinfection procedure if recontamination occurs.

3.02 SEQUENCING

A. Disinfect pipelines after successful pressure testing unless approved otherwise by the Owner.

3.03 DISINFECTION PROCEDURE

A. Flush water pipelines prior to disinfecting. Use potable water for flushing. Operate valves at least twice during flushing process.

B. Disinfect water pipelines in accordance with AWWA C651. Allow potable water and disinfectant solution to flow into pipe at a measured rate so chlorine solution is at a specified strength. Do not place concentrated liquid disinfectant in pipeline or other facilities to be disinfected before it is filled with water.

C. Retain chlorinated water in the piping for a minimum of 24 hours, or for a longer duration when necessary to destroy bacteria.

D. When piping meets disinfection requirements, release disinfecting solution water from the pipeline by flushing to a location acceptable to the owner of the facilities receiving the solution.

E. not make the final connection until the new pipelines system is tested and meets the disinfection requirements.

F. Prior to making final connection to the existing water system, swab or spray hypochlorite solution on the interior surfaces of valves, couplings, pipelines and appurtenances that will be utilized to make the final connection.

3.04 SAMPLE COLLECTION AND TESTING

A. Collect and analyze samples to confirm disinfection process results in compliance with Health Department regulations and AWWA standards.

1. Obtain samples bottles that are free of contamination from testing laboratory.

2. Obtain chain of custody documents from testing laboratory.

B. Provide valves at sample points.

C. Utilize the services of a certified testing laboratory to obtain and test samples to confirm pipelines meets requirements of AWWA C651 and the State Health Department. Repeat the disinfection procedures if the test results indicate the bacteriological standards are not satisfied.

3.05 PLACING POTABLE OR RECYCLED WATER FACILITIES IN SERVICE

A. After pipelines and other facilities have been disinfected, refill with [potable] [recycled] water. Obtain additional water samples and analyze for conformance to bacteria limits for public water supplies.

B. If analytical results indicate compliance with bacteria limits, place new facility in service.

C. If analytical results indicate treated pipelines do not meet bacteria limits, repeat disinfection procedures and analytical testing of new samples until regulated water quality limits are satisfied.

END OF SECTION

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SECTION 33 39 13

PRECAST CONCRETE MANHOLES

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This Section includes materials, testing, and installation of precast concrete manhole for sewer and storm water appurtenances.

1.02 REFERENCE STANDARDS

A. ASTM A48 – Gray Iron Castings

B. ASTM A159 – Standard Specification for Automotive Gray Iron Castings

C. ASTM C361 – Reinforced Concrete Low-Head Pressure Pipe

D. ASTM C478 – Precast Reinforced Concrete Manhole Sections

E. ASTM C923 – Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes

F. ASTM C990 – Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

G. ASTM D1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3))

H. ASTM D2922 – Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

1.03 QUALITY ASSURANCE

A. All materials furnished under this Section shall be:

1. From a manufacturer who has been regularly engaged in the design and manufacture of the materials for at least five (5) years; and

2. Approved by the engineer before installation. The Engineer shall verify that the product and quality is equal to the materials made by those manufacturers specifically named herein, or if an alternate product manufacturer is proposed.

1.04 SUBMITTALS

A. The Contractor shall submit for approval by the Engineer the following:

1. Manufacturer's literature on the materials identified on the Drawings and in this specification. Literature shall include recommended installation procedures.

2. Certification by the manufacturer that all precast sections furnished under this specification were manufactured, sampled, tested, and inspected in accordance with ASTM C478 or ASTM C361.

3. Mix design of the concrete used for the manhole base.

4. Frame, grates, rings, and covers.

5. Material to be used for pipe connections at manhole walls.

PART 2 - PRODUCTS

2.01 MANHOLES

A. Precast Concrete Manholes

1. All precast concrete manhole sections shall conform to the details shown on the Drawings and specified herein. Precast manhole sections shall be manufactured in accordance with ASTM C478 “Precast Reinforced Concrete Manhole Sections”. Manholes shall be leak free structures. Structures constructed with precast sections shall be constructed using a single manufacturers products and/or with products recommended by the precast section manufacturer.

2. Manhole Sizes

Pipe Diameter	Manhole Diameter	Cover Diameter
21 inch and smaller	48 inch	24 inch
24 inch and 27 inch	60 inch	24 inch
30, 33 and 36 inch	72 inch	24 inch

3. Manhole Joints

a. Manhole joints shall be tongue and groove style.

B. Manhole Cones

1. Standard manhole cones shall be concentric.

C. Manhole Bases

1. Manhole bases shall be cast-in-place in accordance with the Drawings and this specification. Concrete for manhole base shall be 6-sack with a 4,000 psi rating. Top of base channel shall be six inches (6”) above the crown of pipe.

D. Manhole Inlet

1. For manholes with more than one inlet, the invert of the smaller inlet shall be at or above the centerline of the larger pipe. Channel for the side entry shall be properly shaped to provide minimum turbulence in the manhole.

E. Ladder Rungs

1. Manhole ladder rungs shall be installed for all manholes deeper than four feet (4’). Rungs shall be made of one-half inch (½”) diameter grade 60 steel with Copolymer Polypropylene coating. Steps are to be cast in place during manufacturing of precast barrels and cones.

F. Joint Sealer

1. Joints in precast manhole sections shall be made of "Ram-Nek" preformed flexible plastic joint sealant or neoprene gaskets.

2. External joints shall be wrapped with JK Polysource M-860, or approved alternate.

2.02 MANHOLE FRAMES AND COVERS

A. Non-pressure type manhole frames and covers shall be Phoenix Iron Works P-1090 or D&L Supply A-1024, or equal.

B. Pressure type manhole frames and covers shall be Phoenix Iron Works P-1002 (bolt-down), or equal. Both manhole frames and covers shall meet all requirements of ASTM A159, "Automotive Gray Iron Castings."

C. Manhole covers shall be labeled “Sanitary Sewer”.

D. Manhole covers shall have at least one center pick hole and one edge pry hole.

E. Adjustment rings shall NOT be used on any sewer manhole. Frames must be raised.

F. Anchor bolts shall be fabricated as specified by the equipment manufacturer and, unless otherwise indicated, shall be stainless steel. Cone shall be drilled to accept three-fourths inch (¾”) stainless steel inserts. Manhole rim is to be bolted down prior to the pouring of the concrete cap

PART 3 - EXECUTION

3.01 CONNECTIONS TO EXISTING MANHOLES

A. Pipe connections to existing manholes shall be done under the direction of the Owner and other applicable requirements specified for new manholes, including all necessary concrete work, cutting and shaping of channel.

B. All PVC and HDPE pipe entering or leaving a manhole shall have a rubber sealing gasket as supplied by the pipe manufacturer, firmly seated perpendicular to the pipe axis, around the pipe exterior and cast into the structure base or near the wall center as a water stop. Water stop may also consist of a manhole coupling with rubber rings cast into the structure base.

C. Existing flow shall be maintained through a bypass. A bypass plan shall be submitted and the Contractor shall be solely responsible for maintaining the bypass and shall be liable for any fines by any agency as a result of any spill or overflow.

3.02 ABANDONMENT OF EXISTING MANHOLES

A. Manholes to be abandoned shall have their cones removed, backfilled and compacted to ninety-five percent (95%) relative compaction. Frames and covers not to be reused shall be delivered to the Owner as directed by the Owner.

3.03 MANHOLES

A. Manhole Bases

1. Manhole bases shall be cast-in-place unless specified otherwise. The Contractor shall not deviate from plan dimensions, notwithstanding over-excavation or other detrimental field conditions, unless approved by the Owner. A forming ring shall be used to form a level joint groove in fresh concrete of the manhole base to receive the precast barrel section of the manhole. The metal forming ring shall be removed after the concrete has sufficiently set to eliminate any slump in the joint groove.

2. Manhole bases shall be poured over twelve inches (12”) of ¾-inch drain rock over undisturbed material. Manhole drain rock shall be compacted to a relative compaction of ninety percent (90%) per ASTM D1557 and ASTM D2922.

3. Manhole Channels: Where sewer lines ingress and egress manholes pipe shall be used to form the channel. After the base concrete has set, the channel shall be shaped to the final required configuration. Perpendicular channel sides shall not be allowed. All channels shall be approved by the Owner.

4. All connections shall provide for a watertight seal between the pipe and the manhole. The connector shall be the sole element relied upon to assure a flexible water tight seal of the pipe to the manhole.

5. When connecting new pipe to existing manholes, a channel and bench walls shall be installed.

6. The pipe up to the structures shall not project beyond the inside wall of the structure and in no case shall the socket of a vitrified clay pipe be built into the wall of a structure.

B. Joints in precast manhole sections shall be filled using "Ram-Nek" or approved equal in the joint space between matching parts. After placement of the subsequent section, excess sealant squeezed from joint shall be removed and the joint area troweled smooth. Special precautions shall be taken to ensure that the entire joint space is filled with sealant. Apply mortar to all joints.

C. Apply concrete sealant “XYPEX Concentrate” 2 coats to manhole base and 1 coat to inside and outside of barrels.

3.04 WORKING ON EXISTING MANHOLES

A. When work is to be performed above the flow channel of existing manholes, plywood shall be used to cover the entire channel and a drop cloth shall be used to cover the entire base and prevent any debris from entering the flow-channel. Noncompliance will result in the suspension of that portion of the Contractor’s work for the day until the precautionary measures are put in place. No contract time extensions will be granted due to said suspension of work. This precaution shall be taken to prevent debris from entering or obstructing the flow to the Collection System.

B. Sanitary sewer connections to existing manholes shall be core-drilled and made using a flexible rubber seal / waterstop. Saw cutting and hammer through taps are prohibited.

3.05 ADJUSTING EXISTING FRAMES AND COVERS TO GRADE

A. General

1. Before any work is performed on existing manholes, plywood shall be used to cover entire channel and a drop cloth be used to cover the entire base. This precaution shall be taken to prevent debris from entering the Collection System. Existing frames, covers, or adjustment rings removed during adjustments may be reinstalled only if the materials are undamaged and only if approved in advance by the Owner.

2. Manholes shall be raised flush with the finished grade of the new road surface. The maximum allowable tolerance shall be one-fourth inch (¼") measured with a straightedge.

3. Manhole frame and cover shall be shimmed. The void between the top of manhole cone or ring and the cover frame shall be filled with cement mortar.

4. No bricks, shims or any other device shall be left as part of final construction.

5. Manhole covers shall have no other holes, other than the center pick hole and side pry hole.

B. Downward Adjustments

1. Downward adjustments can be made by removal of grade rings, mortar, concrete or brick. At no time shall the cone be modified in any way.

C. Manhole Surface Block

1. Manhole surface blocks (collars) are required on all manholes. A block is to be poured around each adjusted frame. The block is to be eighteen inches (18") wide as measured from the outside edge of the cover and twelve inches (12") thick. Concrete is to be poured no more than two inches (2") from final grade and rough finished to accept asphalt overlay. Frame is then to be grouted to grade to grade rings and cone.

3.06 TESTING

A. The Contractor shall conduct an exfiltration test or vacuum test on each manhole constructed. The test shall be conducted by the Contractor in the presence of the Owner.

B. Exfiltration tests shall consist of plugging incoming and outgoing sewer lines and filling the manhole with water up to the rim. After initial absorption (15 minutes), if the water loss exceeds one inch in depth in five minutes, the manhole shall have failed the test. Each manhole which fails the test shall be carefully inspected to determine the problem and then resealed and retested until the water loss is less than one inch in five minutes.

C. Vacuum tests shall consist of drawing a vacuum on a sealed manhole and measuring the time for the vacuum to drop to a predetermined level. The actual test procedure shall be provided by the manufacturer of the test equipment and approved by the Owner. Each manhole which fails the test shall be carefully inspected to determine the problem and then resealed and retested until the manhole passes.

END OF SECTION

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SECTION 40 05 07

PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Hangers and supports for all piping systems specified in Sections 40 05 10.

B. This section does not include pipe supports for fire sprinkler systems, pipe anchors, guides or seismic restraints.

C. For seismic restraint requirements for piping, see Section 40 05 96.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this section

1. Section 01 33 00 – Submittals
2. Section 01 61 11 – Seismic Anchorage and Bracing
3. Section 05 50 01 – Anchor Bolts and Anchoring Devices
4. Section 40 05 10 – Piping Systems
5. Section 40 05 96 – Seismic Restraints for Piping

1.03 QUALITY CONTROL

A. Operating Conditions

1. The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:

a. Hot Systems: A. 120°F to 450°F.

b. Ambient Systems: B. 60°F to 119°F.

c. Cold Systems: C-1. 33°F to 59° F, C-2. -20°F to 32°F.

B. Hanger and Support Selection

1. Select pipe hangers and supports as specified. Base selections upon the pipe support classifications specified in this section and any special requirements which may be specified in the contract documents.

2. Review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

3. Design and select hangers and supports to withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consider the following conditions:

a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.

b. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

c. Reaction forces due to the operation of safety or relief valves.

d. Wind, snow, or ice loadings on outdoor piping.

4. Size hangers and supports to fit the outside diameter of pipe, tubing, or, where specified, the outside diameter of insulation.

5. Where negligible movement occurs at hanger locations, use rod hangers for suspended lines, wherever practical. For piping supported from below, use bases, brackets or structural cross members.

6. For the suspension of size 2-1/2" and larger pipe and tubing, use hangers capable of vertical hanger component adjustment under load.

7. Provide supporting systems which provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.

8. Where there is horizontal movement at a suspended hanger location, select hanger components to allow for swing. Do not permit the vertical angle of the hanger rod to exceed 4º at any time.

9. Do not permit contact between a pipe and hanger or support component, constructed of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by using copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.

10. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.

11. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.

12. Stock hanger and support components shall be used wherever practical.

1.04 INDUSTRY STANDARDS

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between this section and the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).

C. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued.

D. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction, - 13th Edition
OSSC	2019 Oregon Structural Specialty Code
FEDSPEC WW-H-171e	Hangers and Supports, Pipe
MFMA-4	Metal Framing Manufacturer's Association, Metal Framing Standards Publication
MSS SP-58	Manufacturers Standardization Society Pipe Hangers and Supports—Materials, Design and Manufacture
MSS SP-69	Manufacturers Standardization Society Pipe Hangers and Supports—Selection and Application

1.05 SUBMITTALS

A. Provide hanger and support locations, load calculations, and manufacturer layout and detail drawings as part of the submittals for equipment and piping coordination and installation drawings required in Section 40 05 10.

B. The load and support design calculations shall be stamped and signed by a licensed Civil or Structural Engineer in the State of Oregon. Comply with Sections 01 61 11 and 05 50 01. Coordinate calculations with those required by Section 40 05 96.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. B-Line

B. Carpenter & Paterson

C. Kin-Line

D. Anvil International

E. Michigan

F. Pipe Shields Incorporated

G. Superstrut

H. Unistrut

I. Or equal as specified in Section 01 33 00.

J. Comply with MSS SP-69 and FEDSPEC WW-H-171e for pipe support components and MFMA-4 for framing systems

2.02 PRODUCTS

A. Material

1. Pipe hangers and supports, structural attachments, rack and trapeze supports, fittings and accessories: 316 stainless steel.

2. Nuts, bolts, washers, and other fasteners: Type 316 stainless steel.

3. Safety end caps on all framing channels.

4. Comply with MSS SP-58 for supports and MFMA-4 for framing systems.

B. Pipe Hangers and Supports

1. Type 1 – Clevis Pipe Hanger, configuration and components equivalent to MSS and FEDSPEC Type 1.

   a. Steel pipe (insulated): B-Line B3100, Anvil International 260, or equal, with insulation shield.

   b. Steel pipe (uninsulated): B-Line B3100, Anvil International 260, or equal.

   c. Cast and ductile iron pipe: B-Line B3102, Anvil International 590, or equal.

   d. Copper pipe (uninsulated): B-Line B3104 CT, Anvil International CT-65, or equal.

   e. Copper pipe (insulated): B-Line B3100, Anvil International 260, or equal, with insulation shield.

   f. Plastic pipe: B-Line B3100 C, Carpenter & Paterson Fig. 100PVC, or equal.

2. Type 2 – J Pipe Hanger, configuration and components equivalent to MSS Type 5

   a. Steel pipe: B-Line B3690, Anvil International 67, Michigan model 418, or equal.

   b. Copper and plastic pipe: Michigan model 419, Unistrut J 1205N series, or equal.

3. Type 3 – Double Bolt Pipe Clamp, configuration and components equivalent to MSS and FEDSPEC Type 3.

   a. Steel pipe (insulated): B-Line B3144, Anvil International 295, or equal, with insulation shield. Insulation shield is optional for hot and ambient systems.

   b. Steel pipe (uninsulated): B-Line B3144, Anvil International 295, or equal.

   c. Copper pipe (insulated only): B-Line B3144, Anvil International 295, or equal, with insulation shield.

4. Type 4 – Adjustable Roller Hanger, configuration and components equivalent to MSS Type 43 and FEDSPEC Type 44.

   a. Steel pipe (insulated): B-Line B3110, Anvil International 181, or equal, with insulation shield.

   b. Steel pipe (uninsulated): B-Line B3110, Anvil International 181, or equal.

   c. Copper pipe (insulated only): B-Line B3110, Anvil International 181, or equal, with insulation shield.

   d. Plastic pipe: B-Line B3110, Anvil International 181, or equal.

5. Type 5 – Single Pipe Roll, configuration and components shall be equivalent to MSS Type 41 and FEDSPEC Type 42.

   a. Steel pipe (insulated): B-Line B3114, Anvil International 171, or equal, with insulation shield.

b. Steel pipe (uninsulated): B-Line B3114, Anvil International 171, or equal.

c. Plastic pipe: B-Line B3114, Anvil International 171, or equal.

6. Type 6 – Framing Channel Pipe Clamp

a. Steel pipe (uninsulated):

1) Pipe size 3/8" and 1/2": 16-gage;

2) 3/4" through 1 1/4": 14 gage;

3) 1-1/2" through 3": 12-gage;

4) 3 1/2" through 5": 11- gage;

5) 6 and 8": 10-gage;

b. Michigan Model 431, Powerstrut PS 1100, Unistrut P 1109 series, or equal.

c. Steel pipe (insulated): Pipe clamp as described in Paragraph 2.02 B.6.a with insulation shield.

d. Copper (uninsulated) and plastic pipe:

1) Pipe size 3/8" and 1": 16-gage;

2) 1-1/4" and 1-1/2": 14-gage;

3) 2" through 3": 12-gage;

4) 4": 11-gage;

5) Clamp: copper-plated, plastic coated or lined with dielectric material;

6) Michigan model 432, Powerstrut PS 1200, Unistrut P 2024C and P 2024PC series, or equal.

e. Copper pipe (insulated): Pipe clamp shall be as described in Paragraph 2.02 B.6.a with insulation shield.

7. Type 7 – U-Bolt Configuration equivalent to MSS and FEDSPEC Type 24.

a. Steel pipe (uninsulated): Anvil International. 137, B-Line B3188, or equal.

b. Steel pipe (insulated): Anvil International. 137, B-Line B3188, or equal, with insulation shield.

c. Cast and ductile iron pipe: Anvil International. 137, B-Line B3188, or equal.

d. Copper pipe (uninsulated): Carpenter & Paterson Fig. 222 CT, B-Line B3501 CT, Anvil International. 137C, or equal.

e. Copper pipe (insulated): Anvil International. 137, B-Line B3188, or equal, with insulation shield.

f. Plastic pipe: Anvil International. 137C, Michigan model 151, B-Line B3188 C, or equal.

8. Type 8 – Adjustable Pipe Roll Support

a. Steel pipe (insulated): B-Line B3122, Anvil International. 177, or equal, with insulation shield.

b. Steel pipe (uninsulated): B-Line B3122, Anvil International. 177, or equal.

c. Copper pipe (insulated only): B-Line B3122, Anvil International. 177, or equal, with insulation shield.

d. Plastic pipe: B-Line B3122, Anvil International. 177, or equal.

9. Type 9 – Welded Pipe Stanchion

a. Minimum material thickness: standard schedule pipe, cut to match contour of the pipe elbow.

b. Limit use of this support to ambient systems only.

10. Type 10 – Pipe Stanchion Saddle and Yoke, comply with MSS Type 37 and FEDSPEC Type 38.

a. Steel pipe (insulated): Carpenter & Paterson Fig. 125, B-Line B3090, or equal, with insulation shield.

b. Steel pipe (uninsulated): Carpenter & Paterson Fig. 125, B-Line B3090, or equal.

c. Cast and ductile iron pipe: Carpenter & Paterson Fig. 125, B-Line B3090 NS, or equal.

d. Copper pipe (uninsulated): Carpenter & Paterson Fig. 125, B-Line B3090, or equal, with insulation shield or lined with dielectric material.

e. Copper pipe (insulated): Carpenter & Paterson Fig. 125, B-Line B3090, or equal, with insulation shield.

f. Plastic pipe: Carpenter & Paterson Fig. 125, B-Line B3090, or equal.

11. Type 11 – Offset Pipe Clamp, Provided with configuration and components specified using standard designs offered by a pipe hanger component manufacturer.

a. Steel pipe (insulated): B-Line B3148, Anvil International 103, or equal, with insulation shield.

b. Steel pipe (uninsulated): B-Line B3148, Anvil International 103, or equal.

c. Cast and ductile iron pipe: B-Line B3148 NS, Anvil International 103, or equal.

d. Copper pipe (insulated): B-Line B3148, Anvil International. 103, or equal, with insulation shield.

e. Copper pipe (uninsulated): B-Line B3148, Anvil International. 103, or equal, lined with dielectric material.

f. Plastic pipe: B-Line B3148, Anvil International. 103, or equal.

g. Vertical pipe support applications: as specified above except do not use insulation shields for insulated pipe.

12. Type 12 – Riser Clamp, configuration and components equivalent to MSS and FEDSPEC Type 8.

a. Steel pipe (insulated): B-Line B3373, Anvil International 261, or equal.

b. Steel pipe (uninsulated): B-Line B3373, Anvil International 261, or equal.

c. Cast and ductile iron pipe: B-Line B3373, Anvil International 261, or equal.

d. Copper pipe (insulated): B-Line B3373 CT, Anvil International CT-121, Michigan model 511, or equal.

e. Copper pipe (uninsulated): B-Line B3373 CT, Anvil International CT-121, Michigan model 511, or equal.

f. Plastic pipe: B-Line B3373, Anvil International. 261c, or equal.

13. Type 13 – Framing Channel Pipe Strap, configuration equivalent to MSS Type 26.

a. Steel pipe (uninsulated): Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.

b. Steel pipe (insulated): Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.

c. Copper pipe (uninsulated): Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield or lined with dielectric material.

d. Copper pipe (insulated): Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.

e. Plastic pipe: Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.

C. Rack and Trapeze Supports

1. General

a. Unless otherwise specified, provide trapeze and pipe rack components minimum thickness of 12 gage, with a maximum deflection 1/240 of the span.

2. Type 20 – Trapeze Pipe Support

a. For trapeze pipe support cross members, use framing channel as specified in Paragraph 2.02 E.5. For flat plate fittings, 1-5/8" square standard design manufactured by framing channel manufacturer, Unistrut P2471, B-Line B202-2, or equal.

3. Type 21 – Pipe Rack Support

a. For post and cross members, use framing channel as specified in Paragraph 2.02 E.5. For pipe rack fittings, use standard design manufactured by framing channel manufacturer. For 90º fittings, use gusseted Unistrut P2484, B-Line B844, or equal. Provide post base fittings as specified in Paragraph 2.02 D.5.

D. Structural Attachments

1. Type A –Insert For Concrete:

a. Concrete inserts: Comply with MSS and FEDSPEC Type 18.

b. Anvil International 282, Carpenter & Paterson Fig. 108, or equal.

2. Type B – Side Beam Bracket

a. Comply with MSS Type 34 and FEDSPEC Type 35.

b. Anvil International. 202, B-Line B3062, or equal.

3. Type C –Beam Clamp with Extension Piece

a. Comply with MSS and FEDSPEC Type 30.

b. Anvil International. 218 with Fig. 157 extension piece, B-Line B3054, or equal.

4. Type D – Beam Clamp with Eye Nut
   a. Beam clamp and eye nut: forged stainless steel.
   b. For configuration and components, comply with MSS and FEDSPEC Type 28.
   c. Anvil International. 292, Carpenter & Paterson Fig. 297, or equal.
5. Type E – Framing Channel Post Base
   a. Standard design offered by framing channel manufacturer.
   b. Single channel: Unistrut P2072A, B-Line B280, or equal.
   c. Double channel: Unistrut P2073A, B-Line B281, or equal.
6. Type F – Welded Beam Attachment
   a. Comply with MSS and FEDSPEC Type 22. B-Line B3083, Anvil International. 66, or equal.
7. Type G – Welded Steel Bracket
   a. Comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket.
   b. Comply with MSS Type 33 and FEDSPEC Type 34 for heavy welded bracket.
8. Type H –Bracket
   a. Carpenter & Paterson Fig. 340, or equal.
9. Type J – Adjustable Beam Attachment
   a. Carpenter & Paterson Fig. 151, B-Line B3082, or equal.
10. Type K – Double Channel Bracket
   a. Wall channel: single channel framing channel as specified in Paragraph 2.02 E.5.
   b. Cantilever bracket: double framing channel assembly, Unistrut P2542 through P2546, B-Line B297-12 through B297-36, or equal.
11. Type L – Single Channel Bracket
   a. Wall channel: single channel framing channel as specified in Paragraph 2.02 E.5.
   b. Cantilever bracket: a single framing channel assembly, Unistrut P2231 through P2234, B-Line B198-6, B198-12, B196-18 and B196-24, or equal.
12. Type M – Wall Mounted Channel
   a. Wall channel: single channel framing channel as specified in Paragraph 2.02 E.5.
13. Type N – Pipe Stanchion Floor Attachment
   a. Base plate: 1/2” minimum thickness.
   b. Make anchor bolt holes 1/16” larger than the anchor bolt diameter.

c. Fill space between the base plate and the floor with nonshrink grout.

E. Accessories

1. Hanger Rods

a. Rods: threaded on both ends or continuous threaded and sized as specified.

2. Weldless Eye Nut

a. Eye nut: forged stainless steel and complying with MSS and FEDSPEC Type 17.

b. Manufacturer: Anvil International. 290, B-Line B3200, or equal.

3. Welded Eye Rod

a. Weld-eye rod closed. Make inside diameter of eye a bolt diameter 1/8" larger than the rod diameter.

b. Manufacturer: Anvil International. 278, B-Line B3211, or equal.

4. Turnbuckle

a. Turnbuckle: forged stainless steel and complying with MSS and FEDSPEC Type 13.

b. Manufacturer: Anvil International. 230, B-Line B3202, or equal.

5. Framing Channel

a. Framing channel: 1-5/8" square, roll formed, 12-gage.

b. Provide channel with a continuous slot along one side with in-turned clamping ridges.

c. Single channel: Unistrut P1000, B-Line B22, or equal.

d. Double channel: Unistrut P1001, B-Line B22A, or equal.

e. Triple channel: Unistrut P1004A, B-Line B22X, or equal.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT LOCATIONS

A. Locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc.

B. Locate hangers, supports and accessories within the maximum span lengths specified in the contract documents to support continuous pipeline runs unaffected by concentrated loads. Indicate hanger and support locations and components on the piping layout drawings required by Paragraph 1.05. For pipe support submittals, provide a complete cross reference of each support by mark number, including the page number on which each mark number can be found. Set up the cross reference to permit review from the mark numbers to the drawings, not the other way around.

C. Locate at least one hanger or support within 2' from a pipe change in direction.

D. Locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.

E. Where piping is connected to equipment, a valve, piping assembly, etc., that will require removal for maintenance, support piping so temporary supports are not necessary.

F. Locate pipe supports to prevent "pockets" from forming in pipe between supports due to excessive deflection under load from weight of pipe, medium in the pipe, insulation, valves and fittings.

3.02 INSTALLATION

A. Construct welded and bolted attachments to the building structural steel which comply with the AISC Manual of Steel Construction. Unless otherwise specified, do not drill or burn holes in the building structural steel.

B. Do not use hanger components for purposes other than for which they were designed. Do not use components for rigging and erection purposes.

C. Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

D. Use embedded anchor bolts that satisfy the OSSC provisions instead of concrete inserts for supports in areas below water surface or normally subject to submergence.

E. When hanger and support components are in contact with plastic pipe, make sure the components are free of burrs and sharp edges.

F. Ensure rollers roll freely without binding.

G. Roughen finished floor to a ¼ inch amplitude beneath structural attachments and framing channel post bases prior to grouting. Place grout, free of voids and foreign material, between base plate and floor.

H. Cut and drill base plates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

I. Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 7’ above the floor.

3.03 ADJUSTMENTS

A. Adjust hangers and supports to obtain required pipe slope and elevation.

B. Use shims made of material that is compatible with the piping material.

C. Adjust stanchions prior to grouting their base plates.

END OF SECTION)

SECTION 40 05 10

PIPING SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish all piping, including fittings, supports, and accessories shown on the Drawings and described herein, to completely interconnect all equipment and valves for a complete and operable system.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittals
2. Section 09 96 00 – High Performance Coatings
3. Section 40 80 02– Testing Pressure Piping

1.03 REFERENCES

A. The standards listed below are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
ASTM D2467	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D2855	Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
ASTM F402	Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ANSI B16.12	Cast Iron Threaded Drainage Fittings
AWWA C104	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile Iron Piping
AWWA C110	Ductile-Iron and Gray-Iron Fittings
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings

Reference	Title
AWWA C115	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C153	Ductile-Iron Compact Fittings
AWWA C207	Steel Pipe Flanges for Waterworks Service
AWWA C219	Bolted Sleeve-Type Couplings for Plain-End Pipe
AWWA C606	Grooved and Shouldered Joints

1.04 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspect of this specification and shall include, but not be limited, complete manufactures' data on pipe material fitting, fasteners and hardware, gaskets, linings, and coatings. Comply with Section 01 33 00 and provide the following information:

B. Product Technical Data

1. Submit product data on pipe, fittings, joints and joining materials, gaskets, linings, coatings, hardware, piping connections, piping accessories, and other components.

2. Manufacturers' certifications of compliance with the specified standard.

3. Pipe wall thickness and pressure class

C. Fabrication and/or Layout Drawings

1. Submit schedule of piping systems that will be used and services that they will be used for.

    a. For the Critical Piping Area shown on the Drawings, submit a detailed piping layout plan and profile view, including electrical ducts. The submittal shall also include a sequence of construction for installation of pipe in this area.

2. Before preparation of shop drawings, installation conditions, including existing utilities and structures, shall be verified by excavation, inspection, and measurement. Submit field measurements and photos with shop drawings where exposed conditions differ significantly from the conditions indicated on the Drawings.

3. Submit detailed layout drawings of all piping. Schematics may be submitted for piping 3 inches and smaller. Drawings shall include:

    a. Dimensions of pipe diameter and length

    b. Invert or centerline elevations and sizes of pipe crossings, intersecting ductwork, intersection conduit/conduit racks, or other potential interferences requiring coordination

    c. Centerline elevations for pressure pipelines and invert elevations for gravity flow pipelines

    d. Bury depth for buried yard piping

    e. Location and type of pipe supports and anchors

f. Location of valves and valve actuator type

g. Location and details of fittings, tapping locations, thrust blocks, joint restraints, couplings, flexible expansion joints, connections to equipment, piping accessories, thermal insulation, and related appurtenances.

h. Line slopes and vents

i. Thrust restraints for restrained joints including materials, sizes, assembly rating and pipe attachment methods.

j. Thrust blocks: concrete quantity, bearing area on pipe, and fitting joint locations.

4. Submit schedule of interconnections with existing piping and method of connection.

D. Test Reports

1. Submit certified test reports as required herein and by the referenced standards specifications.

2. Submit field test reports as required in PART 3.

1.05 QUALITY ASSURANCE

A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least five (5) years.

B. Factory Quality Control: The Contractor shall test all products as noted herein and by the reference specifications.

C. Field Quality Control:

1. The Contractor shall:

a. Perform leakage tests.

b. Be responsible for the costs of additional inspection and retesting by the Owner resulting from noncompliance.

PART 2 - PRODUCTS

2.01 GENERAL

A. Pipe sizes are nominal inside diameter unless otherwise noted. All sizes of pipe shall be as called out on the Drawings and specified herein.

B. All pipe and fittings delivered to the job site shall be clearly marked to identify the material, class, thickness, and manufacturer.

C. All material shall be new and free of blemishes.

D. Where only one type of pipe is called out, no substitutions shall be allowed.

E. Piping materials of like kind shall be the product of one manufacturer.

F. The Contractor is responsible for furnishing and installing all items necessary to make a complete and workable piping system. This includes, but is not limited to, valve boxes, insulating couplings and gaskets, piping specialties, and all other items required by the nature of the installation. Any item not specified herein but required by the installation

shall be of first quality, equal in grade to similar materials specified herein, and shall comply with all applicable reference standards listed herein.

G. All materials (pipe, fittings, gaskets, linings, etc.) in contact with the potable water or process water to be treated to potable water shall be lead-free and NSF 61 certified.

H. Paint exposed pipe in conformance with requirements of Section 09 96 00.

2.02 PIPE MATERIALS

A. Pipe and Fitting Designation:

1. Piping materials are identified by a "Type" designation in these specifications.

2. Specific piping materials and other pertinent information is summarized for each pipe type.

3. Pipelines are designated on the Drawings by a two-element code, the first representing the nominal pipe diameter and the second an abbreviation indicating the piping system.

4. The following schedules, except where indicated otherwise on the Drawings, identify pipe type to be used for each piping system. Where the pipe type is not specifically identified on the Drawings, materials shall be selected based on the pipe service as listed in the following schedule and specified in subsequent articles of this specification.

B. Pipe Type Schedule:

Abbr.	Fluid Description	Size	Service	Pipe Type
INF	Influent Pump Station Discharge	All	E	DIP-F
INF	Influent Pump Station Inlet	36"	B	PVC-R
FM	Influent Pump Station Forcemain	All	B	HDPE
RDPS	Recycle Drain Pump Station Forcemain	All	B	HDPE
PS	Primary Sludge	All	B	HDPE
PSC	Primary Scum	All	B	HDPE
SL-D	Digested Sludge	All	B	HDPE
SL-WAS	WAS Sludge	All	B	HDPE
DR	Drain (Process)	All	B	HDPE
PFD	Perforated Drain	All	B	PVC-PF
SD	Storm Drain	All	B	PVC-S
SS	Sanitary Sewer	All	B	PVC-S
W	Potable Water	1-inch & >	B	DIP-R
W	Potable Water	1-inch	E	PEX
Service: B=Buried; E=Exposed; C=Concrete Encased; F=Flanged, PF=Perforated, S=Submerged, R=Restrained.				

C. Ductile Iron Pipe – Flanged (DIP-F)

1. Pipe

   a. Ductile iron flanged pipe, AWWA C115 or ductile iron grooved end pipe: Ductile iron pipe, AWWA C151 with grooves in accordance with AWWA C606, Table 3, for rigid joints. Provide minimum thickness classes in accordance with AWWA C606.

   b. Minimum Pressure Class: 350

   c. Minimum Wall Thickness: 53

2. Fittings

   a. Ductile iron, AWWA C110.

   b. Special fittings not available in ductile iron may be fabricated of epoxy lined and coated welded steel pipe with a design pressure of 350 psi. Submit design and wall thickness to Engineer for review.

3. Joints

   a. Provide flanged or grooved couplings are required in the Drawings

   b. Flanges: Ductile iron flange, in accordance with AWWA C115 and AWWA C110 and faced and drilled to 125 lb ANSI B16.1 standards.

   c. Grooved Coupling: Mechanical grooved couplings, in accordance with AWWA C606, and minimum pressure rating of 150 psi.

4. Bolts and Nuts

   a. Above ground and exposed pipe: Corrosion resistant, high strength, low alloy carbon steel hex bolts, conforming to AWWA C115.

   b. Underground, in concrete valve boxes, or underwater: Type 304 Stainless Steel.

5. Gaskets

   a. Gaskets for flanged joints shall be 1/16 in. thick (1/8 in. thick for pipes 12 in. and larger), rubber conforming to applicable parts of ANSI B16.12 and AWWA C115 and C207.

   b. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in potable water lines.

   c. Gaskets shall be one piece with holes to pass bolts.

6. Lining and Coatings

   a. Lining: Ceramic epoxy lined with Protecto 401 or equal.

   b. Coating: Exterior of exposed pipe shall be painted in accordance with Section 09 96 00.

D. Ductile Iron Pipe – Restrained (DIP-R)

1. Pipe

   a. Ductile iron restrained pipe per AWWA C151.

   b. Minimum Pressure Class: 350

   c. Minimum Wall Thickness: 53

2. Fittings

   a. Ductile iron with push-on joints or mechanical joints, AWWA C110 or C153.

   b. Special fittings not available in ductile iron or cast iron pipe may be fabricated of welded steel pipe with a design pressure of 350 psi. Submit design and wall thickness to Engineer for review.

3. Joints

   a. Conforming to AWWA C111.

   b. Push-on or mechanical joints, except where flanged joints are shown on the Drawings.

   c. For all connections, provide restrained joints for pipe and fittings that create a change in pipe size and on fittings that result in a change of direction, whether the change is in the horizontal plane or a vertical plane.

   d. Manufacturers: One of the following, or equal.

      1) Push-on Joints

         a) Fastite Joint as manufactured by American Cast Iron Pipe Company.

         b) Pacific States Cast Iron Pipe Company.

         c) Tyton Joint as manufactured by U.S. Pipe.

      2) Restrained Push-on Joints

         a) United States Pipe and Foundry Company, TR Flex.

         b) Pacific States Cast Iron Pipe Company, Thrust Lock.

         c) American Cast Iron Pipe Company, Flex Ring or Lok-Ring.

      3) Restrained Mechanical Joints

         a) Pacific States Cast Iron Pipe Company, Lock Mechanical Joint.

         b) American Cast Iron Pipe Company, MJ Coupled Joint.

         c) EBBA Iron, Megalug.

   e. Flexible Coupling – For IPS Influent Pipe

      1) Dynamic Moving Joint

      2) Victualic W257

4. Gaskets

   a. Synthetic rubber compound in which the elastomer is nitrile or neoprene, conforming to AWWA C111. Lubricant for push-on joint piping shall be the pipe manufacturer's standard.

5. Bolts and Nuts

   a. Buried, for mechanical joints: Type 304 Stainless Steel.

6. Lining and Coatings

   a. Lining:

      1) Ceramic epoxy lined with Protecto 401 or equal for INF.

2) Cement lined for W.

b. Polyethylene encapsulated per AWWA C105.

E. Polyvinyl Chloride - Pressure (PVC-S)

1. Pipe: less than 4”
2. Fittings: Match pipe, SDR 35, ASTM D3034 or PS 46, ASTM F679.
3. Joints: Bell and Spigot, with reference mark for proper spigot insertion
4. Gasket: Synthetic rubber in compliance with ASTM D3212 and ASTM F477.
5. Installation: In compliance with manufacturer’s instruction and ASTM D2321.
6. Lining and Coatings: None.
7. Provide plastic and magnetic tracer tape.

F. Polyvinyl Chloride - Gravity (PVC-S)

1. Pipe: 4” to 15”, SDR-26, ASTM D3034
2. Pipe: 18” to 36”, PS 46, ASTM F679
3. Fittings: Match pipe, SDR 35, ASTM D3034 or PS 46, ASTM F679.

a) Joints: Elastomeric gasket, ASTM

4. Gasket: Synthetic rubber in compliance with ASTM F477.
5. Installation: In compliance with manufacturer’s instruction and ASTM D2321.
6. Lining and Coatings: None.

G. Polyvinyl Chloride - Pressure (PVC-PF)

1. Pipe and fittings: Plastic underdrain pipe, ASTM F758, Type PS 46 (SDR 35).
2. Joints: Gasketed bell and spigot.
3. Installation: In compliance with manufacturer’s instruction and ASTM D2321.
4. Lining and Coatings: None.

H. High Density Polyethylene Pipe (HDPE)

1. Pipe and fittings for sizes 4-inch diameter and larger:
   a. Pipe: Comply with per ANSI/AWWA C906, ASTMJ F714, ASTM D3035.
   b. Pressure Rating: DR 17, 125 psi
   c. Fittings shall match the pipe SDR pressure rating. All fittings shall be molded and fabricated by the manufacturer.
   d. Joints: Join all HDPE pipe and fittings by the heat fusion process per ASTM A2657 and the manufacturer’s specific recommendations.
   e. Pipe Compound: PPI TR PE 4710
   f. Installation: In compliance with manufacturer’s instruction and ASTM D2321.
   g. Lining and Coatings: None.

I. PEX

1. PEX piping shall be PEX-B type.

2. All plumbing piping shall be 5-layer PEX-c with the following layers

   a. Inner PEX-c layer

   b. Adhesive layer

   c. EVOH layer

   d. Adhesive layer

   e. Outer PEX-c layer

3. Piping shall conform to ASTM F876, ASTM F877 and CSA B137.5.

4. Piping shall be NSF certified.

5. Pipe shall be rated for continuous operation of 100 psi gauge pressure at 180^{o}F temperature (690 kPa at 82^{o}C) and 80 psi gauge pressure at 200^{o}F (550 kPa at 93^{o}C.

6. Manufacturers: Zurn or equal.

2.03 MISCELLANEOUS PIPING CONNECTIONS

A. Refer to pipe material specifications for typical pipe joints. Furnish other joint devices where called for on the Drawings, as specified below.

B. Transition Fitting from HDPE to DIP

1. All transition from HDPE pipe to ductile iron shall be made per the approval of Engineer and per the HDPE pipe manufacturer's recommendations and specifications. A molded flange connector adapter within a stainless steel back-up ring assembly shall be used for pipe type transitions. Ductile iron back-up rings shall mate with cast iron flanges per ANSI B16.1.

   a. Transition from HDPE to ductile iron fittings and valves shall be approved by Engineer before installation.

   b. No solid sleeves shall be allowed between such material transitions.

   c. The pipe supplier must certify compliance with the above requirements.

C. Flexible Couplings and Flanged Coupling Adapters (FCAs)

1. Furnish and install flexible couplings and flanged coupling adapters where shown on the Drawings or required by installation.

2. All couplings shall be restrained and suitable for a minimum working pressure of 150 psi.

3. Longitudinal movement and angular defections capabilities shall meet AWWA C219.

4. Materials

   a. Sleeves: Galvanized steel or have a fusion bonded coating suitable for potable water.

   b. Followers: Cast iron, ductile iron, or steel.

   c. Sleeve Bolts: Type 304 SS.

d. Gaskets: Synthetic rubber suitable for potable water.

5. Manufacturers

a. Steel pipe or steel pipe sizes with identical outside diameters: Smith-Blair Type 411; Dresser Style 38; or equal.

b. Cast or ductile iron pipe with identical outside diameters: Smith-Blair Type 441; Dresser Style 138; or equal.

c. Connecting pipes with slightly different outside diameters: Rockwell Type 413 or R441; Dresser Style 62; or equal.

D. Rubber Expansion Joints

1. Type: Built-up single arch expansion joints with full flanges and retainer rings. Provide filled arch type for services with solids.

2. Materials: EDPM cover over reinforced nylon or polyester body and EDPM tube with galvanized steel retainer ring. Cover shall have protective coating where installed outdoors.

3. Pressure and Temperature Rating

a. Up to 12-inch-diameter: 190 psi, 250°F

b. Larger than 12-inch-diameter: 80 psi, 250°F

4. Manufacturers: Proco Series 230; Garlock Style 204HP

5. Provide galvanized steel control rod-compression sleeve assemblies for all rubber expansion joints, except where specifically omitted in Drawings. The number and size of the control rods shall be as required for the test pressure of the pipe system or 50 psi, whichever is greater.

6. Provide full size intermediate metal pipe flanges where rubber spool connects with wafer-style valves, lug-style valve, or other items that do not have full face metal flanges.

2.04 MISCELLANEOUS PIPING ACCESSORIES

A. Dielectric Flange Kits

1. Components

a. Dielectric Gasket: 1/8-inch thick, full faced, phenolic, non-asbestos

b. Bolt Sleeves: 1/32-inch wall thickness

c. Insulating Washers: 1/8-inch thick, phenolic

2. Pressure and Temperature Rating: 175 psi, 210°F

3. Manufacturers

a. PSI;

b. George Fischer;

c. Or equal.

B. Dielectric Unions

1. Connections: Screwed end

2. Pressure and Temperature Rating: 175 psi, 210°F

3. Manufacturers

   a. Epco;

   b. George Fischer;

   c. Or equal.

C. Polyethylene Encasement

1. The surfaces of all buried metallic pipe, fittings, and couplings shall be encased with two sheets of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the piping and surrounding earth or backfill material.

2. Polyethylene material shall conform to the requirements of AWWA C105. Material shall be 8 mil, linear low density polyethylene (LLDPE) and shall be marked at two foot intervals with manufacturer's name, year of manufacture, AWWA C105, film thickness and material, pipe size, and repair warning.

D. Plastic Warning Tape

1. Provide a single line of plastic warning tape 2.5 feet above the centerline of each buried pipe. Spread tape flat with message side up before backfilling.

2. Print two messages on the tape with bold letters approximately 2" high. Messages shall be repeated at maximum intervals of 2 feet.

   a. First message: CAUTION

   b. Second message: BURIED PIPE BELOW

3. Dimension: 6-inch wide; 0.5 mil thick.

4. Material: Inert plastic material suitable for direct burial.

5. Color: Colors shall meet the APWA Color-Code standard for identification of buried utilities.

6. Manufacturers

   a. Brady;

   b. Seton;

   c. Or equal.

E. Link Seals

1. Where shown on the plans, provide link seals and compatible wall sleeves with weep ring for wall penetrations.

2. Use manufacturers recommended service designation unless noted otherwise.

3. Type: Linked rubber sealing elements and pressure plates tightened together with stainless steel bolts.

4. Manufacturers

   a. Thunderline Corporation;

   b. Calpico;

c. Or equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE

A. General

1. All pipes shall be carefully placed and supported at the proper lines and grades and, where possible, shall be sloped to permit complete drainage. Piping runs shown on the Drawings shall be followed as closely as possible, except for minor adjustments to avoid architectural and structural features. If major relocations are required, they shall be approved by the Engineer.

2. Wherever a pipe three inches in diameter and larger passes from concrete to earth, two flexible pipe couplings, shall be installed within 1 foot of the concrete. Particular care shall be taken to ensure a full support of the pipe in the earth between and beyond the joints.

3. When installing buried PVC pipe, it shall be "snaked" in the trench. In addition, PVC pipe shall not be laid when temperature is 32°F, or below. Piping shall be installed without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.

B. Exposed Pipe

1. Exposed pipe shall mean any pipe not buried or encased in concrete. In erecting exposed pipe a sufficient number of screw unions, flanged or grooved end type joints shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Flanges and grooved couplings shall be employed on pipes 2-1/2 inches and larger. The provision of an adequate number of appropriate take-down fittings must be rigidly adhered to whether or not such fittings are indicated on the Drawings. Take-down fittings shall also be provided within two feet of threaded valves and other appurtenances. Where piping passes through concrete or masonry walls, take-down fittings shall be employed within 3 feet of the wall.

2. All exposed pipelines shall accommodate expansion and contraction forces by the use of expansion joints, anchors, and pipe guides. Where pipes cross structure expansion joints, rubber spherical molded type pipe expansion joints with restraining rods shall be installed whether specifically shown or not.

3. All unrestrained joints in pressure pipelines, including bell and spigot, flexible couplings, expansion joints and flange adapters shall have tension bars (tie rods) provided in accordance with AWWA M11 Design Manual, Figures 19.15 and 19.16, and Tables 19.7 and 19.8. Thrust protection shall be for 1-1/2 times the specified test pressure for the pipe.

C. Buried Pipe

1. General

a. All buried pipes shall be prepared as herein before specified and shall be laid on the prepared granular base and bedded to ensure uniform bearing. No pipe shall be laid in water or when, in the opinion of the

Engineer, trench conditions are unsuitable. Joints shall be made as herein specified for the respective types. Take all precautions necessary to prevent uplift and floating of the pipe prior to backfilling.

b. Piping under slabs and structures shall be encased in concrete unless otherwise directed by the Engineer.

2. Gravity Lines

a. Laying of gravity pipelines shall proceed upgrade with the spigot ends pointing in the direction of flow. Each piece shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line. As the work progresses, the pipe interior shall be cleared of all dirt and debris of every description. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At times when work is not in progress, open ends of pipe and fittings shall be closed.

3. Corrosion Protection

a. All buried metal parts such as valves and bolt-ups not cement mortar coated shall be coated with two coats of bitumastic in accordance with Section 09 96 00, and encased with two sheet of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the protected metal and surrounding earth. All polyethylene shall be secured in place with 10-mil polyethylene tape.

4. Dielectric Connections

a. Where pipes of dissimilar metals are connected, a dielectric insulator shall be provided. Where copper pipe is supported from hangers, it shall be insulated from the hangers; or copper plated hangers shall be used.

b. Dielectric insulators shall be installed on the first exposed flanges or couplings of pipes which are connected to buried piping. For this purpose, an insulating joint or connection shall be provided on exposed existing and new piping which requires cathodic protection, within ten feet of each point of burial. Where connections are made between existing ferrous metal piping and new piping, which is to receive cathodic protection, a dielectric insulator shall be installed.

c. Insulating flange gasket sets shall be installed at the specified locations. All insulating components shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved ohmmeter, and the minimum resistance shall be 50,000 ohms. All insulating flanged joints shall be coated as shown.

d. Insulating unions shall be installed at the specified locations. Joint compound or thread tape shall be applied to male threads only. Piping shall be worked into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Threads shall be engaged so that no more than 3 threads remain exposed.

5. Locating Wire

a. All runs of water pipe, including services, shall have a No. 10 gauge solid soft drawn copper wire laid along the pipe to facilitate locating the pipe at a later date. The wire shall be stubbed up inside each valve box. Continuity test shall be conducted on each splice at all locations.

3.02 MODIFICATIONS AND CONNECTIONS TO EXISTING PIPING

A. Coordinate with the Owner of the existing pipeline to be connected to prior to making connection.

B. Perform demolition of existing pipelines and yard piping as shown or necessary to make connection. Preserve, in undamaged condition, piping that is to remain and where connections are to be made as part of the Work.

C. Modify and connect to existing piping in accordance with the materials, joint requirements, welding, coatings, linings, and other provisions of this Section. Where specific details are indicated on the Drawings, provide the pipe connections, joints, fittings, and appurtenances as indicated.

D. Coordinate with the Owner to have the pipeline de-energized. Affect lock-out/tag-out procedures as necessary to prevent the accidental use of the pipeline.

E. Carefully cut existing pipe using saws and cutting equipment acceptable to Engineer. Do not torch cut metallic pipe for preparation of pipe at connections.

F. Grind ends of steel pipe to remove corrosion and foreign materials where sleeve couplings are to be installed. Power tool clean and epoxy coat pipe ends prior to assembly for sleeve and grooved end-type couplings.

G. Use pipe fittings for modifications and connections. Do not use saddle-type connections unless specifically indicated on the Drawings.

H. Complete pressure testing and obtain Owner’s approval prior to making connections to existing piping systems, unless otherwise indicated.

3.03 INSTALLATION OF PIPE CONNECTIONS

A. Flexible Couplings and FCAs

1. Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Wipe gaskets clean before they are installed.

2. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends.

3. Install in accordance with the manufacturer's instructions and recommendations.

4. Tighten bolts progressively, drawing up bolt on opposite sides a little at a time until all bolts have a uniform tightness. Workers tightening bolts shall be equipped with torque-limiting wrenches.

B. Flexible Expansion Joints

1. Install in accordance with the manufacturer's instructions and recommendations.

2. Connect expansion joints only to full-face metal flanges.

3. Install control rod-compression sleeve assemblies with control rod nuts snug, to relieve stress on adjacent pipe, except at buried locations. Comply with manufacturer's instructions.

4. Paint buried galvanized steel retainer rings, bolts and other appurtenances in accordance with Section 09 96 00.

3.04 INSTALLATION OF PIPE ACCESSORIES

A. Polyethylene Encasement

1. All polyethylene encasements shall be secured in place with 10-mil polyvinyl tape. Installation shall conform to requirements of AWWA C105, Method A. Excess slack width in the polyethylene tube shall be taken up to make a snug, but not a tight fit, and secured with an adhesive tape wrapping around the pipe at the quarter points of each pipe length.

2. Any rips, punctures or other damage to the polyethylene sleeve shall be repaired with two layers of adhesive tape or a short length of polyethylene tube cut open, wrapped around the pipe, and secured in place.

3.05 INSTALLATION OF THERMAL INSULATION

A. General

1. Apply over clean, dry surfaces.

2. For double layer insulation, where specified or required to achieve the specified surface temperature, provide with staggered section joints.

B. Pipe Supports and Shields

1. Unless otherwise specified, provide thermal pipe hanger shields install during pipe support installation.

2. Where thermal pipe hanger shields are used, apply 3" wide vapor barrier tape or band over the butt joints.

C. Protection

1. Protect insulation and jackets from crushing, denting, and similar damage during construction.

2. Do not penetrate or otherwise damage vapor barriers.

3. If insulation, jacket, and vapor barriers are damaged during construction, then remove damage material and install new material.

D. Piping Insulation

1. Continuously insulate along entire length including all in-line devices such as valves, fittings, flanges, couplings, strainers and other piping appurtenances.

2. Unless otherwise specified, provide with aluminum jackets.

3. Butt firmly together and provide jacket laps and joint strips with lap adhesive.

4. Provide jackets with their seams located on the underside of pipe.

5. Except for flexible blanket type, seal insulation ends with end joint strips and held in place by waterproof adhesive.

E. Fittings, Connections, Flanges and Valves:

1. Except where soft covers are specified, provide rigid insulation with rigid aluminum covers.

2. Mechanically secure by corrosion-resistant tacks pushed into the overlapping throat joint.

3. Overlap the adjoining pipe insulation and jackets.

4. Provide with their seams located on the underside of fittings and valves.

F. Flashing

1. Provide at jacket penetrations and terminations. Provide clearance for flashing between insulation system and piping supports.

2. Sealant

a. Trowel a heavy tack coat of sealant over the insulation, extending over the jacket edge 1-inch and over the pipe or protrusion 2 inches.

b. Stretch reinforcement over the tack coat after clipping to fit over pipe and jacket.

c. Strap clipped reinforcing with a continuous band of reinforcing to prevent curling.

d. Trowel sealant over the reinforcement to a minimum thickness of 1/8--inch.

3. Provide aluminum caps, formed to fit, over the adjacent jacketing and to completely cover coated insulation. Hold cap in place with a jacket strap.

3.06 CLEANING

A. The interior of all pipelines shall be thoroughly cleaned of all dirt, loose scale, sand, and all foreign material prior to connection of pipe to equipment, control and regulating devices, and instrumentation and prior to testing. Pump suction lines shall be cleaned prior to operation of pumps.

B. Cleaning shall be accomplished by flushing with water at a velocity of at least 3 feet per second or by pulling a tightly fitting cleaning ball or swab through the pipe.

C. No test shall commence until the pipeline is completely cleaned to the satisfaction of the Engineer.

3.07 FIELD TESTING

A. All pipelines installed in this project shall be subject to field and acceptance tests as specified in Section 40 80 02.

END OF SECTION

SECTION 40 05 51

GENERAL REQUIREMENTS FOR VALVES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for valves.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittals
2. Section 40 05 10 – Piping Systems

1.03 SUBMITTALS

A. Comply with Section 01 33 00.

B. Provide the following information, at a minimum:

1. Shop drawings
    a. Valves and actuators
2. A schedule of valves indicating the label location, attachment method, and proposed label text for each valve.
3. A schedule of responsible manufacturers for the project and contact information, planned site visits, and compliance tests to be performed.
4. Design calculations, test and performance data, and other information required to substantiate that the valve units proposed will meet the performance requirements specified and shown.
5. Protective Coatings: Manufacturer's data.

1.04 DEFINITIONS

A. Responsible Manufacturer: Manufacturer or manufacturer's representative who will ensure satisfactory performance of equipment.

B. Valve: Device for mechanically regulating pipeline flow.

C. Actuator: Devices added to obtain mechanical advantage or power assist in operation.

1.05 RESPONSIBLE MANUFACTURER

A. Furnish, adjust, test, and ensure satisfactory performance of each valve.

B. Provide any field adjustments, settings, and tests required for satisfactory performance of each valve at no additional cost to Owner.

1.06 QUALITY ASSURANCE

A. Factory test one valve of each type supplied for a particular service for valves less than 4" in diameter. For all other valves, test each valve.

1. Test steel-bodied valves hydrostatically per ANSI B16.5

2. Test aluminum-, bronze- and brass-bodied valves hydrostatically at double the maximum pressure specified.

3. Leakage, sweating or visible deformation at any point on the valve is cause for rejection of valves of that type and manufacturer.

B. Submit a certified copy of the pressure test reports for all valves over 12 inches in nominal size prior to shipping valves to the site. Format these test press er the requirements of the applicable reference standards.

C. Storage and Preparation for Installation

1. Package and store valves to prevent exposure to sunlight, chemical exposure, and atmospheric pollution.

2. Inspect each valve prior to installation for damage. Repair any damage to seats, machined surfaces, or protective coatings before installation. Clean each valve to remove any dirt and debris from the interior surfaces and seat areas. Install valves in the closed position.

3. Some valves must be installed with seats or seat adjustment rings on the downstream side of the valve. Determine these requirements prior to installation and install the valve in the correct orientation.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide valves, gates, actuators, stem extensions, and other accessories as indicated on the Drawings or specified. All valves shall be new and of current design. For valves of the same type, provide identical valves supplied by a single manufacturer.

B. Provide valves and actuators with the name of the manufacturer, nominal size, flow direction arrow, design working pressure, and the reference standard cast in raised letters or indelibly marked on an appropriate part of the body.

C. Provide buried valves with valve boxes and covers where indicated.

D. Flanges, gaskets, and bolts for valves: in accordance with Section 40 05 10.

E. Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B62.

F. Wetted parts shall be lead-free as defined by Oregon Health Authority, US EPA, or the most stringent of current regulations.

2.02 PROTECTIVE COATINGS

A. Coat ferrous surfaces in water passages of all valves of size 2 inches and larger and exterior surfaces of valves and actuators, with epoxy per AWWA C550, unless otherwise specified in the valve specification.

1. Interior Surfaces:

a. Minimum dry film thickness: 8 mil

b. NSF/ANSI 61 approved.

2. Exterior Surfaces:

a. Above ground:

1) Minimum dry film thickness: 8 mil

b. Buried, submerged or in blow ground vaults:

1) Minimum dry film thickness: 12 mil

B. Do not coat flange faces or bronze and stainless steel surfaces in water passages.

C. Coat exterior bronze and stainless steel surfaces using the same system as the associated piping.

D. Provide holiday-free protective coatings.

2.03 VALVE ACTUATORS

A. Furnish valves and gates with an actuator as indicated in the valve Technical Specification.

B. Assemble valve actuators to the valve, adjust, and test the completed unit by Responsible Manufacturer prior to shipment to the Site.

PART 3 - EXECUTION

3.01 VALVE INSTALLATION

A. Install valves per the manufacturer's written instructions and as indicated on the Drawings and specified.

B. Fit, support and brace gates to prevent warping, binding, and bending under all operating conditions. Accurately position and support embedded parts cast into concrete during concrete placement.

C. Assembly of Valves and Piping

1. Install valves with piping per Section 40 05 10 and per this Section.

2. Install valves with piping prior to the assembled piping or attached supports being cast into concrete or attached to supports.

3. Sequence construction and operations so that the adjacent piping supports the valves, and so that the valves do not support the piping. Where permanent supports are located at valves, install the supports after the piping and valves have been installed as a completed assembly on temporary supports.

4. Install piping and valve assemblies so that the piping does not exert forces on the valves from settlement or assembly operations.

5. Correct piping alignment deviations before the valve is joined to the piping.

6. Unless shown otherwise, install butterfly, plug, and ball valves with the shafts in the horizontal position.

7. Install gates, gate valves, and other types of valves with the stems in the vertical position.

8. For manually operated valves 3 inches in nominal size and smaller, orient the valve operators and indicators to be visible to the operator.

D. Install floor boxes, valve boxes, extension stems, and floor stands vertically centered over the operating nut, with couplings as required. Adjust the elevation of the box top to conform with the elevation of the finished floor, grade, or pavement at the completion of the Work. Support boxes and stem guides during concrete placement to maintain vertical alignment and proper orientation.

3.02 TESTING

A. Pressure test valves as part of the pipeline testing. Demonstrate valve operation (open/close) after the valve is installed including valve box and riser, as appropriate.

B. Following installation, Owner may conduct holiday test for valves larger than 30-inch.

END OF SECTION

SECTION 40 05 57.13

MANUAL VALVE AND GATE OPERATORS AND OPERATOR APPURTENANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Manual operators for valves and gates, and operator appurtenances.

B. Contractor shall provide all tools, supplies, materials, equipment, and labor necessary for furnishing, installing, adjusting, and testing of valve actuators.

C. Provide manual operators as indicated on the Plans.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittals
2. Section 40 05 10 Piping Systems
3. Section 40 05 51 – General Requirements for Valves

1.03 SUBMITTALS

A. Comply with Section 01 33 00 and include information as noted below.

B. Manufacturer's catalog information and other data confirming conformance to design and material requirements.

C. Submit shop drawings for actuators as part of the submittals for the associated valves in accordance with Section 40 05 60.

D. Submit design calculations showing the required valve operation torques and the design torque provided by each actuator.

PART 2 - PRODUCTS

2.01 GENERAL

A. Supplier shall supply and mount all actuators, including any type of manual or powered actuators, on the valves at the factory. Each valve and actuator shall be shipped as a unit.

B. Each actuator shall have sufficient torque capacity and features to seat, unseat, and rigidly hold in any intermediate position the valve it controls under the operating conditions for the valve.

C. Provide each actuator with an externally mounted mechanical valve position indicator.

D. Each valve body or operator shall have cast thereon the word "OPEN", an arrow indicating the direction to open, and flow direction arrows.

2.02 OPERATORS

A. General:

1. Unless otherwise indicated, nonburied valves shall have an operating wheel, on the actuator. Buried valves shall have AWWA 2-inch operating nuts and non-rising stems. Unless specified otherwise, the direction of rotation of the operator shall be counterclockwise for opening.

B. Wrench Nuts, Boxes, and Guides:

1. Wrench nuts shall comply with Section 3.15 of AWWA C500. A minimum of two operating keys, but no fewer than 1 key per every 10 valves, shall be provided for operation of the wrench nut operated valves.

C. Gear Actuators

1. Unless otherwise noted, gear actuators shall be provided for the following.

a. Valves larger than 12 inches in nominal size

b. Buried valves that have the operating shaft mounted horizontally

c. Where specified or shown

d. Where a lever or wheel operator effort would otherwise be greater than 60 foot -pounds of torque or 60 pounds of force at the rim of the wheel or lever

2. Gear actuators shall be of the worm or helical gear type with the output shaft perpendicular to the valve shaft and a removable hand wheel mounted on the output shaft. Except as required herein, the gear actuators shall conform to AWWA C504 and shall be certified.

3. Actuators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.

4. Gearing shall be machine-cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and seals and to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant, and be of the same material as the valve body.

5. Manual input effort to the handwheel shall be a maximum of 40 foot pounds for operating the valve from full open to full close, under any operating conditions. Gear operators shall indicate valve position and have adjustable stops. Maximum handwheel size shall be 24 inches in diameter. Minimum handwheel size shall be 12 inches.

2.03 OPERATOR APPURTENANCES

A. Valve Boxes:

1. Valve boxes shall be cast iron and shall have suitable base castings to fit properly over the bonnets of their respective valves and heavy top sections with stay-put covers. Covers shall be hot-dip galvanized.

B. Floor Boxes:

1. Floor boxes shall be hot-dip galvanized. Where the operating nut is in the concrete slab, the floor box shall be bronze bushed. Where the operating nut is below slab, the opening in the bottom of the box shall be sufficient for passage of the operating key. Floor boxes for operating nuts recessed in concrete shall be standard cast iron boxes cast into the concrete, with fastening top by Clow, or equal.

C. Adjustable Shaft Valve Boxes:

1. Adjustable shaft valve boxes shall be concrete or cast iron Brooks No. 3RT, Christie G5, Empire 7-1/2 valve extension box, or equal. Box covers on water lines shall be impressed with the letter "W". Gas line covers shall be impressed with the letter "G".

D. Stem Guides

1. Stem guides shall be of the adjustable wall bracket type, bronze bushed, with maximum spacing of 10 feet as manufactured by Clow, Rodney Hunt, or equal. Extended operating stems shall have universal joints and pin couplings if longer than 10 feet and a rating of at least five times the maximum operating torque.

PART 3 - EXECUTION

3.01 GENERAL

A. Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.02 OPERATORS

A. General:

1. Valves and gates shall be provided with manual operators, unless specified otherwise. Where possible, manual operators shall be located between 48" and 60" above the floor or a permanent work platform.

B. Wrench Nuts:

1. Wrench nuts shall be provided on buried valves, on valves which are to be operated through floor boxes, and where specified. Extended wrench nuts shall be provided if necessary so that the nut will be within 6" of the valve box cover.

3.03 OPERATOR APPURTENANCES

A. Valve Boxes:

1. Valve boxes extending to finished surfaces shall be provided for buried valves.

B. Floor Boxes:

1. Floor boxes shall be provided for wrench operation of valves located below concrete slabs. Each floor box and cover shall be of the depth required for installation in the slab.

END OF SECTION

SECTION 40 05 57.23

POWERED VALVE OPERATORS AND OPERATOR APPURTENANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Powered operators for valves and operator appurtenances.

B. Electric Actuator Schedule

Valve or Gate					Actuator			
Location	Type	Size, Inches	Service	Operating Press., ft	Type[1]	Tag No.	Hazardous Area	Dwg Ref
Influent Pump Station	Slide Gate	36	INF	20	EMTT	SLG-110-01	Yes	M-110

[1] See Paragraph 3.04

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 01 66 00 – Product Requirements
3. Section 01 78 23 – Operation Maintenance and Information
4. Section 01 78 36 – Warranties and Bonds
5. Section 01 79 00 – Training
6. Section 01 81 00 – Equipment and System Testing
7. Section 01 99 00 – Reference Forms
8. Section 46 05 13 – General Requirements for Equipment

1.03 DEFINITIONS

A. For use in control valve schedules in other sections and in this section, powered operators are defined as follows:

Operator (OPSPEC) Type	Service	Definition
EMTI	Isolating	Electric motor multi-turn
EMTT	Throttling	Electric motor multi-turn

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Include the following items:

1. Electrical power and control wiring diagrams for electric motor operators marked to show specific changes necessary for the supplied equipment. If no changes are required, the drawing shall be marked “No Changes Required.”

2. Manufacturer's catalog information and other data confirming conformance to design and material requirements.

3. Operating and maintenance information specified in Section 01 78 23.

1.05 QUALITY ASSURANCE

A. Unit Responsibility

1. The valve and/or gate manufacturer shall have unit responsibility, as specified in Section 46 05 13, for equipment, accessories, appurtenances, an power operated actuator. Actuator shall be mounted on valve and/or gate and tested as a unit at the factory.

B. ISO 9001 Quality System

1. Compliance by pump manufacturer is required.

2. Submit documentation of compliance prepared by independent certification agency approved by International Organization for Standardization.

3. Do not ship equipment before compliance documentation review has been completed.

1.06 PRODUCT SHIPMENT, PROTECTION, AND STORAGE

A. Comply with Section 01 66 00.

1.07 WARRANTY

A. Comply with Section 01 78 36.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following:

1. AUMA

2. Rotork IQ series

3. Limitorque MX series

B. Modify equipment if necessary, to comply with this Section.

2.02 COMPONENTS

A. General

1. Size operators to produce an operating torque equal to 1.5 the maximum required valve operating torque under the specified flow conditions.

2. Factory-mount on the valve or gate and provide as a unit.

3. On each valve body or operator cast the word "OPEN", an arrow indicating the direction to open, and flow direction arrows.

4. Specific requirements for each type of powered operator are specified in OPSPEC sheets at the end of this Section.

B. Motor

1. Design specifically for valve or gate actuator service and be of totally enclosed, non-ventilated construction.
2. Suitable for use with 460V, three phase, 60 Hz power.
3. Rate for 15-minute duty and provide with NEMA Class F insulation.
4. Embed thermostat for thermal protection in the motor windings.
5. Minimum Size: As sized by the manufacturer for valve type and service conditions specified, but not more than the size listed in the Electric Actuator Schedule.
6. Motors for throttling (modulating) service shall be designed for 1200 start-per-hour (S4, Class C).
7. Motors in Hazardous Areas shall be explosion proof.

C. Enclosures

1. Rate motor and all electrical enclosures for NEMA 6/IP68.
2. In hazardous areas, rate enclosures for both NEMA 6/IP68 and NEMA 7 Class 1 Div 1 Groups C and D.
3. Enclosure standard: double o-ring sealed to prevent moisture ingress through conduit entry.
4. Local control knobs shall not penetrate actuator housing.

D. Motor Starter

1. Provide with a three phase full voltage reversing starter with overload elements in each of the three poles.

E. Gearing

1. Totally enclose the actuator gearing in an oil-filled gearcase suitable for operation at any angle.
2. Manufacture all drive gearing and components of metal and incorporate a lost-motion hammer blow feature.
3. For rising spindle valves provide a hollow output shaft to accept a rising stem, and incorporate ball or roller thrust bearings at the base of the actuator.
4. Design to permit the opening of the gearcase for inspection or disassembly without releasing the stem thrust or taking the valve out of service.

F. Torque Switch

1. Use solid-state non-contacting electronic means capable of displaying torque percentage on local LCD display.
2. Set point to be determined by valve manufacturer.
3. Permit settings, adjustments, calibration, diagnostics, and datalog file extraction to be accomplished without opening any electrical compartment.
4. Provide PC/PDA compatible software to allow the Owner to perform diagnostics, save operational history and save torque profiles.

G. Manual Operator

1. Provide with a handwheel for manual operation.
2. Design so handwheel does not rotate during motor operation and so a locked motor or locked gearing does not prevent manual operation.
3. For rising stem valves and gates, do not share any gearing with the motor.
4. Provide motor or manual selection using a positive lockable declutching lever which will disengage the motor and motor gearing mechanically but not electrically. Plastic declutch levers are not acceptable.
5. Design to prevent simultaneous operation in manual and motor modes.
6. Design to limit rim effort to 80 lbs of rim effort at maximum torque.

H. Hammer Blow Device

1. Provide with a built-in lost-motion device that allows sufficient travel of the worm gear, prior to engaging the stem nut, for the motor to reach full speed.
2. Through this action, impart a “hammer blow” to start the valve or gate in motion in either direction.
3. Share load equally by two lugs cast integrally on the drive sleeve.
4. Delete hammer blow feature from modulating duty operators.

I. Position Sensing and Remote Indication

1. Sense position without the use of switches via an absolute encoder with no more than four moving parts which has built in redundancy should one of the four parts fail in any way or a similar device. Display position on the LCD as open limit, closed limit, or 1-99% open in 1/10% increments.
2. Provide four software configurable indication contacts as shown in the OPSPEC sheets.
3. Local position display and indication contacts shall update even during loss of main power. External control power shall not be necessary to achieve this.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Locate operators so that they are readily accessible for operation and maintenance.
2. Mount for unobstructed access, but do not obstruct walkways.
3. Do not mount where shock or vibration will impair operation.
4. Do not attach support systems to handrails, process piping, or mechanical equipment.
5. Locate manual operating accessory, where possible, between 48” and 60” above the floor or a permanent work platform.

B. Identification Tags

1. Provide each powered operator with a 16-gage stainless steel identification tag.
2. Inscribe complete equipment number of the operator.
3. Characters: 1/4”, die-stamped.
4. Securely attach to the operator in a readily visible location using stainless steel screws or wire.

C. Electrical Power and Signal Wiring and Equipment

1. Comply with Division 16.

3.02 MANUFACTURER’S FIELD SERVICES

A. Provide field inspection and instruction services by factory-trained service technician of the manufacturer as specified in Sections 01 79 00 and 01 81 00. Services by a sales representative are not acceptable.

1. Provide minimum one (1) visit of 8 hours, excluding travel time, to inspect and test initial operation, and make necessary adjustments.
2. Provide minimum one (1) visit of 8 hours, excluding travel time, to train plant operators.
3. Include one follow up training and troubleshooting session as specified in Section 01 79 00.

B. Complete and submit the following forms in Section 01 99 00:

1. Manufacturers Installation Certification Form
2. Manufacturers Instruction Certification Form

3.03 DEMONSTRATION

A. Comply with Section 01 81 50.

3.04 OPERATOR SPECIFICATION (OPSPEC) SHEETS

A. The following OPSPEC sheets are included in this section: EMTI, EMTT.

Operator Type	EMTI
Description	Electric Multi-turn Isolation valve operator
Construction	AUMA, Rotork IQT or Limitorque Accutronix MX with HBC gearbox, modified to meet the requirements specified in this section.
Gear box	90º gear operator.
Controller	Nonfused disconnect type combination starter in compliance with NEMA ICS.
Controls	1. Control power: Provide by an integral 120 volts AC, single-phase control transformer unless a separate power source is shown on the electrical drawings. 2. Size transformer to operate at not more than 80% of rating with the connected load shown: Include protective secondary fusing. 3. Provide with an integral control station. a. Include ”Local/Stop/Remote” toggle switch and “Open/Close” toggle switch. “Local/Stop/Remote” shall accept standard 1/4” padlock to lock in either position. b. Momentary operation of the “OPEN” or “CLOSE” toggle: Causes the operator to drive the valve or gate to the appropriate limit. Software configuration shall allow push-to-run operation where desirable. c. Momentary operation of the “STOP” pushbutton: Causes the operator to stop. d. Provide terminals for remote “OPEN” and “CLOSE” pushbuttons.
Remote Valve Position/ Actuator Status indication:	1. Provide four contacts (expandable to twelve) which can be selected to indicate any position of the valve or gate. a. Provide for the selection of a normally closed or open contact form. b. Maintain and update position indication during handwheel operation when all external power to the actuator is isolated. c. Rate at 5A, 120V AC, 30V DC. 2. As an alternative to providing valve position, configure so any of the four above contacts may be selected to signal one of the following: a. Valve opening, closing or moving b. Thermostat tripped, lost phase c. Motor tripped on torque in mid travel, motor stalled d. Remote selected e. Actuator being operated by handwheel

Operator Type	EMTT
Description	Electric Multi-Turn Throttling valve operator
Construction	Rotork IQTM or Limitorque Accutronix MX with HBC gearbox and SSMR, modified to meet the requirements specified in this section.
Gear box	90º gear operator.
Controller	1. Provide a solid-state electronic, servo-amplifier comparator and a solid state Triac starting circuit. 2. Accept an external 4- to 20-mA DC isolated position input signal into a maximum load of 250 ohms. 3. Generate a position feedback signal off the indication of an absolute encoder with no more than four moving parts which has built in redundancy should one of the four parts fail in any way 4. Compare the input signal with the feedback signal to produce an error signal. 5. Cause the motor to move the valve or gate in a direction so as to reduce the magnitude of the error signal. 6. Positioning accuracy: Plus or minus 1/10% of travel or better. 7. Operating speeds: 12 in/min for linear operators and 180º per minute for rotary operators. 8. Equivalent to Rotork IQTM.
Controls	1. Control power: Provide by an integral 120 volts AC, single-phase control transformer unless a separate power source is shown on the electrical drawings. 2. Size transformer to operate at not more than 80% of rating with the connected load shown: Include protective secondary fusing. 3. Provide with an integral control station. a. Include “Local/Stop/Remote” toggle switch and “Open/Close” toggle switch. “Local/Stop/Remote” shall accept standard 1/4” padlock to lock in either position. b. Momentary operation of the “OPEN” or “CLOSE” toggle: Causes the operator to drive the valve or gate to the appropriate limit. Software configuration shall allow push-to-run operation where desirable. c. Momentary operation of the “STOP” pushbutton: Causes the operator to stop. d. Provide terminals for remote “OPEN” and “CLOSE” pushbuttons.

END OF SECTION

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SECTION 40 05 60

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish and install valves and appurtenances as shown on the Drawings and described in the Specifications, as required to interconnect with equipment and piping for a complete and operable system.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittal Requirements
2. Section 09 96 00 – High Performance Coating
3. Section 10 14 13 – Piping and Valve Identification Systems
4. Section 40 05 57.13 – Manual Valve and Gate Operators and Accessories
5. Section 40 05 57.23 – Powered Valve Operators and Operator Appurtenances
6. Division 40 – Process Interconnections

1.03 REFERENCES

A. ANSI – American National Standards Institute

B. ASTM – American Society for Testing and Materials

C. AASHTO – American Association of State Highway Transportation Officials

D. AWWA – American Water Works Association

E. NSF – National Sanitation Foundation

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Shop Drawings:

1. Manufacturer's catalog information including product data, details of construction and materials list.
2. Shop drawings showing dimensions, cross-sectional view and weight
3. Data: Submit test reports certifying that manufacturer has performed adequate testing prior to shipment on site.
4. Operation and Maintenance Data: Submit in accordance with Section 01 78 23.

C. Protective Coatings: Manufacturer's data

D. A schedule of valves indicating the label location, attachment method, and proposed label text for each valve.

E. Certifications:

1. Submit certifications to demonstrate compliance with Paragraph 2.01.A (e.g., NSF 61 certification). Quality Assurance

1.05 QUALITY ASSURANCE

A. Factory test one valve of each type supplied for a particular service for valves of diameter less than 4".

B. Test steel-bodied valves hydrostatically per ANSI B16.5

C. Test aluminum-, bronze- and brass-bodied valves hydrostatically at double the maximum pressure specified.

D. Leakage, sweating or visible deformation at any point on the valve is cause for rejection of valves of that type and manufacturer.

E. Submit a certified copy of the pressure test reports for all valves over 12 inches in nominal size prior to shipping valves to the site. Format these test press er the requirements of the applicable reference standards.

F. For gate valves, demonstrate Compliance with Referenced Standard:

1. Testing records per Section 5 of AWWA C509.

2. Affidavit of compliance with AWWA C509.

1.06 STORAGE AND PREPARATION FOR INSTALLATION

A. Package and store valves to prevent exposure to sunlight, chemical exposure, and atmospheric pollution.

B. Inspect each valve prior to installation for damage. Repair any damage to seats, machined surfaces, or protective coatings before installation. Clean each valve to remove any dirt and debris from the interior surfaces and seat areas. Install valves in the closed position.

C. Some valves must be installed with seats or seat adjustment rings on the downstream side of the valve. Determine these requirements prior to installation and install the valve in the correct orientation.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. All valves of each type shall be the product of one manufacturer.

B. Valves shall be complete with all necessary operating hand wheels, chain wheels, extension stems, valve boxes, floor stands, worm and gear operators, operating nuts, chains, hardware and fasteners, and wrenches which are required for the proper completion of the work included under this section.

C. Valves shall be furnished full line size unless specifically called out to be of reduced size. Unless otherwise specified, valves shall be rated for 150 psi working pressure minimum.

D. All exposed valves shall be furnished with operators, handwheels, levers, or other suitable type wrench including handles as specified herein or as shown on the Drawings.

E. Valves 4-inch and larger located more than 7 feet above the floor level shall be furnished with chain operators. Chains shall be galvanized and shall extend to within 3 feet of the floor. Provide hook so that chain may be stored clear of walkways. All buried valves shall be provided with 2-inch-square operating nut and valve boxes.

F. For all buried valves provide valve boxes and extended stems to within 6 inches of finished grade.

G. Unless otherwise indicated, the direction of rotation of the wheel, wrench nut or lever to open the valve shall be counterclockwise.

H. All exposed valves and valve operators shall have a non-bleeding shop coat, unless otherwise specified.

I. All materials in contact with the potable water, process water to be treated to potable water, or liquids (e.g., chemicals) to be added to the process/potable water shall be lead-free and shall meet the requirements of California Code of Regulations Title 22 Chapter 16 Article 7 regarding direct and indirect additives.

J. Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B62.

K. Wetted parts shall be lead-free as defined by Oregon Health Authority, US EPA, or the most stringent of current regulations.

2.02 BUTTERFLY VALVES

A. Manufacturers

1. Pratt, 2FII or XR70;
2. Crispin, K-Flo;
3. DeZurik BAW;
4. Or equal.

B. Design

1. Manufactured in accordance with AWWA C504, except where otherwise specified herein.
2. Pressure Class: 150B.
3. Type: Short body flanged.
4. Disc: Lens-shaped design.
5. Seats: One-piece construction, molded and bonded into the recessed cavity of the valve body. Cartridge type seats with retaining rings are not acceptable.

C. Valve Diameter: Internal diameter of valve at the throat shall be no less than the nominal diameter of the valve less 1-1/2 inches.

D. Materials

1. Shaft: Stainless steel, ASTM A276, Type 304.

2. Disc: Ductile iron, ASTM A536; or cast iron, ASTM A48, Class 40; or cast iron, ASTM A126, Class B; or stainless steel, ASTM A276, Type 316.

3. Disc Edge: Stainless steel, ASTM A276, Type 316.

4. Seat: Buna-N.

5. Body: Cast iron, ASTM A126, Class B.

E. Finish

1. Exposed Exterior: Shop prime compatible with field applied finish coats. Refer to Section 09 96 00.

2. Buried Exterior: Shop coat with high-solids epoxy, 12 mils minimum.

3. Interior: Shop line with two-component, high solids epoxy, AWWA C550.

2.03 RESILIENT SEATED GATE VALVES

A. General Requirements:

1. Use resilient seated type gate valves for valves 3-inches in nominal size and larger.

2. Pressure Ratings:

a. Valves less than 16 inches in nominal size: 200 psi.

b. Valves 16-inch and larger: 150 psi.

3. Type:

a. Exposed Gate Valves: Rising stem type with stem yoke.

b. Buried Gate Valves: Non-rising stem type.

B. Manufacturers: One of the following, or equal:

1. American Darling

2. M&H / Kennedy Valve Company, Model KS-RW.

3. Clow Corporation

4. Mueller Company, 2360 Series.

5. AVK

C. Valve Design:

1. Body, Bonnet, and Wedge: Cast iron conforming to ASTM A126, Class B.

2. Wedge: Fully encapsulated with SBR rubber conforming to ASTM D5000 and meeting rubber-to-metal bond tests specified in ASTM D249.

3. End Connections: Unless otherwise indicated on the Drawings, provide valves with the following end connections:

a. Exposed Gate Valves: Flanged ends conforming to ANSI B16.5.

b. Buried Gate Valves: Mechanical joint or push-on ends.

4. Stem: Cast bronze with integral collars.

5. Stem Packing:

a. Rising stem valves: Teflon braid packing in a stuffing box.

b. Non-rising stem valves: Provide with double or triple o-ring stem seals or with braided packing material.

6. Operator Extension: As indicated on the Drawings.

D. Valve Actuator:

1. Exposed Gate Valves: Provide valve with manual handwheel actuator unless a powered actuator is indicated on the Drawings.

a. Valves 8-inch in Nominal Size and Larger: Provide geared type actuator.

2. Buried Gate Valves: AWWA operating nut on a shaft that extends to within 6 inches below finished grade. Support shaft at 5 foot intervals with the last support just below the operating nut. Provide 42-inch long operating wrench.

3. Operation: Counter clock-wise to open.

E. Coating:

1. Coat interior and exterior of valve body and bonnet with fusion bonded epoxy.

a. Fusion bonded epoxy: Complying with AWWA C550 and NSF/ANSI 61 approved.

2.04 METAL SEATED GATE VALVES

A. Use metal seated type gate valves for valves less than 3-inces in nominal size.

B. Gate Valves Smaller than 3 inches in Nominal Size:

1. Non-rising stem type valve with bronze body, solids wedge disc, screw-in bonnet with PTFE packing.

2. Pressure Rating: 125 psi.

3. Valve Ends: Threaded in accordance with ASME B1.20.1.

4. Coating: Standard factory finish.

C. Manufacturers: One of the following or equal:

1. Crane Company 1700 Series.

2. Jenkins, Figure 47.

3. Mueller H10914.

2.05 BALL VALVES

A. Bronze: Two piece regular port

1. Rating: 600 psi CWP

2. Type: Lever.

3. Connections: Threaded.

4. Materials: Lead-free Bronze body, Zinc-plated steel lever nut, lead free brass stem, RPTFE seat, lead free brass ball, chrome plated, stem packing MPTFE, steel lever, zin-plated with vinyl grit

5. Manufacturers: Apollo 70LF-100 or equal.

B. PVC: full port Tru union type

1. Rating: 250 psi

2. Type: Handle

3. Connections: Threaded or socket

4. Materials: PVC or CPVC Body, FPM or EDPM Seal, Teflon seat, double o-ring stem seal.

5. Installation: Use suitable solvent weld products

6. Manufacturer: Hayward TBH series or equal

2.06 SWING CHECK VALVE

A. Manufacturers

1. Dezurik/Apco Series 6000

2. Equivalent by Golden Anderson

3. Or equal.

B. Design

1. Full waterway, self-aligning disc

2. Pressure Rating: 250 CWP psi

3. Connections: Flanged, 125-pound ANSI.

4. Lever and weight closure control

C. Materials: Ductile iron body and cover, ductile iron disk, stainless steel pivot shafts, stainless steel trim

2.07 AIR RELEASE VALVE – CLEAN WATER

A. Manufacturers

1. Dezurik;

2. Equivalent by Valmatic;

3. Or equal.

B. Design

1. Function: Releases accumulated air under pressure at pipeline high points.

2. Pressure Rating: 150 psi

3. Body style 200 with compound lever.

C. Materials: Cast or ductile iron body; stainless steel float, needle and linkage, Buna-N seat

2.08 COMBINATION AIR RELEASE/AIR VACUUM VALVE – WASTEWATER – (2”)

A. Manufacturers

1. Dezurik Series 145C
2. Equivalent by Valmatic
3. Or equal

B. Design:

1. Releases accumulated air under pressure at pipeline high point.
2. Single body, NPT output, double orifice
3. Pressure rating: 150 psi

C. Materials: Cast or ductile iron body, stainless steel float. Standard epoxy coated

D. Mushroom cap for outlet

2.09 COMBINATION AIR RELEASE/AIR VACUUM VALVE – WASTEWATER – (4")

A. Manufacturers

1. APCO 1800
2. Valmatic 48A/304
3. Or equal

B. Design:

1. Type: Dual body
2. Inlet/Outlet: Flanged unless otherwise indicated
3. Releases accumulated air under pressure at pipeline high point.
4. Single body, NPT output, double orifice
5. Pressure rating: 150 psi

C. Materials: Cast or ductile iron body, stainless steel float. Standard epoxy coated

D. Mushroom cap for outlet

2.10 ECCENTRIC PLUG VALVES

A. General

1. Description: Non-lubricated, eccentric plug-type valve.
2. Suitable for drip-tight, bi-directional shutoff at the specified valve design pressure.

B. Valve Design

1. Port Design
   a. Rectangular shaped.
   b. Port Area:
      1) Valves less than or equal to 20-inches in nominal size: At least 80 percent of the full pipe cross-sectional area.

2) Valves greater than 20-inches in nominal size: At least 70 percent of the full pipe cross-sectional area.

2. Plug Design:

a. Geometry: Eccentrically shaped with a cylindrical seating surface that is offset from the center of the plug shaft.

b. Facing:

1) Encapsulate entire plug with resilient material.

2) Bond between Resilient Facing and Metal Plug: Capable of withstanding 75-pound pull in accordance with ASTM D429, Method B.

3. Valve Seats: Welded-in overlay of not less than 90 percent pure nickel to form a raised area at least 1/8-inch thick for contact with the plug facing. Machine seat after welding to provide a smooth surface.

4. Shaft Bearing and Bottom Bearing:

a. Provide replaceable bearings in the upper and lower shaft trunnions.

b. Design: Sleeve-type, permanently lubricated.

5. Shaft Seal: Chevron type packing seal, held in place with an adjustable gland follower. Valves using O-ring type shaft seals are not acceptable.

C. Valve Body Pressure Ratings

1. Valves 12 inches in nominal size and smaller: 175 psi.

2. Valves 14-inches through 36-inches in nominal size: 150 psi.

3. Valves 42-inches through 54-inches in nominal size: 125 psi.

D. End Connections

1. Valves 3 inches and Smaller: Threaded ends.

2. Valves Larger than 3 inches:

a. Exposed Piping Systems: Flanged end connections with flange dimensions, facing and drilling conforming to ANSI B16.1, Class 125.

b. Buried Piping Systems: Mechanical joint end connections conforming to ANSI A21.11/AWWA C606.

E. Materials of Construction

1. Body: Cast iron, ASTM A126, Class B.

2. Plug: Cast iron, ASTM A126, Class B, or cast iron ASTM A436 (Ni-resist), or ductile iron, ASTM A536.

3. Plug Facing: Neoprene or Buna-N.

4. Body Seats:

a. Valves less than 3 inches in nominal size: Cast iron, ASTM A126, Class B.

b. Valves 3 inches in nominal size and larger: Stainless steel, ASTM A276, Type 304 or nickel.

5. Stem Packing: Buna-N or PTFE.

6. Plug Bearings: Type 316 stainless steel.

7. Bolts, Studs, Nuts and Washers: Zinc plated in exposed installations, Type 316 stainless steel in buried installations.

F. Shop Applied Interior and Exterior Coatings

1. Interior Surfaces: Apply two coats Ameron Amerlock 400, Kop Coat Carboline 890LT, or equal. Apply each coat to 4 to 5 mils thick.

2. Exterior Surfaces: Apply polyurethane coating system consisting of one coat primer, one intermediate coat of polyamide epoxy, and one final coat of polyurethane.

a. Primer and Intermediate Coats: Ameron Amerlock 400, Kop Coat Carboline 890LT, or equal. Apply each coat to 4 to 5 mils thick.

b. Finish Coat: Ameron Amercoat 450HS, Kop Coat Carboline 134HS, Tnemec Series 74 Semi-Gloss Endura-Shield, or equal. Apply 1.5 to 2 mills thick.

2.11 VALVE ACTUATORS

A. General

1. Furnish all valves with operators, handwheels, levers, or other suitable handles as shown on the Drawings or specified herein.

2. Furnish chain operators for valves 4-inches and larger located more than 7-feet above the floor. Provide a hook to store the chain clear of walkways.

3. Provide 2-inch-square operating nut for all buried valves. See Section 40 05 57.13 for additional valve operator appurtenances for buried valve.

4. All threaded stem valves shall open by turning the valve stem counter clock-wise.

2.12 PRESSURE GAUGE ASSEMBLY

A. Complete installation, unless otherwise shown, shall include ¾-inch plug valve isolation at the main, a gauge protector made specifically for solids handling service, a snubber and gauge. Provide a support plate to the nearest flange.

B. Plug Valve: Shall be DeZurik PEC; or equal. Connections shall be threaded

C. Protector: Shall be for slurry service with flushing connection. Body shall be steel or cast iron. Diaphragm shall be removable of Type 316 stainless steel. Complete unit shall be Trerice, M & G (U.S. Gauge), or equal.

D. Gauges and Snubbers: Shall be as specified for System A.

E. Installation: All protectors and gauge bourdon tubes shall be evacuated of air, glycerin filled at the factory and factory calibrated.

F. See Division 40 for additional instrumentation requirements, including installation, calibration, and testing requirements.

G. Manual Valve Operators: See Section 40 05 57.13 for additional requirements.

H. Powered Valve Operators: See Section 40 05 57.23 for motorized valve actuators.

1. Wye Strainers

a. Materials

b. Connections: True union.

c. Strainer shall have hex cap for access to screen.

d. Supply with 1/2-inch brass gauge cock.

PART 3 - PRODUCTS

3.01 INSTALLATION

A. Install valves in accordance with the manufacturer's recommendations.

B. Valves installed in vertical runs of pipe shall have their operating stems oriented to facilitate the most practicable operation, as approved by the Engineer.

C. Install butterfly valves in accordance with the manufacturer's published recommendations and AWWA C504.

D. Provide valve tags for valve identification. See Section 10 14 13.

3.02 TESTING

A. Test valves at the same time that the adjacent pipeline is tested.

B. Joints shall show no visible leakage under test. Joints that show signs of leakage shall be repaired prior to final acceptance.

C. Protect any special parts of control systems or operators that might be damaged by the pipeline test. The Contractor shall be held responsible for any damage caused by the testing.

D. If requested by the City, the valve manufacturer shall furnish an affidavit stating the materials options furnished, and/or that these and other referenced specifications have been complied with.

3.03 FIELD PAINTING

A. Paint exposed valves in accordance with Section 09 96 00.

B. Coat all buried metal parts such as valves and bolt-ups not cement mortar coated with two coats of bitumastic in accordance with Section 09 96 00 and encased with one sheet of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the protected metal and surrounding earth.

C. Secure all polyethylene in place with 10-mil polyethylene tape.

END OF SECTION

SECTION 40 05 65

FABRICATED STAINLESS STEEL GATES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Design, fabrication, installation and testing requirements for the for the fabricated stainless steel slide gates, weir gates, stop gates, and necessary appurtenances to provide a complete and operable installation.

B. Equipment List

1. The equipment specified in this section in listed in the gate schedule included at the end of this section.

1.02 REFERENCED SPECIFICATION SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 01 66 00 – Materials and Equipment
3. Section 01 78 23 – Operations and Maintenance Data
4. Section 01 78 36 – Warranties and Bonds
5. Section 01 79 00 – Training
6. Section 01 81 00– Equipment and System Testing
7. Section 05 50 01 – Anchor Bolts and Anchoring Devices
8. Section 40 05 57.23 – Powered Valve Operators and Operator Appurtenances

1.03 DEFINITIONS

A. Design Head (Seating or Unseating): The hydrostatic head representing the differential pressure that the gate is to be designed to withstand and for which the actuator is sized to accommodate.

B. Seal: Resilient material attached to the slide plate or the gate frame that function to prevent leakage.

C. Seat: The horizontal and vertical bearing surfaces that support the slide plate that function to prevent leakage.

D. Slenderness Ratio (L/R): The ratio of maximum unsupported stem length to stem cross-section radius of gyration.

E. Self-contained: The arrangement of gate actuator, supported by the gate frame, such that the operating thrust loads are not applied to the gate assembly.

F. EPDM: Ethylene propylene diene monomer.

G. RMS: Root Mean Square.

H. UHMWPE: Ultra high molecular weight polyethylene.

1.04 DESIGN REQUIREMENTS

A. Reference Standard: Provide slide gates conforming to AWWA C561.

B. Design gates in accordance with the performance requirements specified below and to withstand the seating and unseating head conditions specified in the Gate Schedule provided at the end of this Section.

1. Ultimate and Yield Tensile, Compressive and Shear Strength Criteria:

a. Apply safety factor of 4.0 with regard to ultimate tensile, compressive and shear strength.

b. Apply safety factor of 2.0 with regard to tensile, compressive and shear yield strength.

2. Slide Plate and Frames:

a. Minimum thickness of structural members: 1/4-inch.

b. Slide Plate Deflection: Not more than 1/360 of the plate span, or 1/8-inch, whichever is less, at the specified maximum hydraulic head.

3. Seat and Seals: Seat contact pressure shall not exceed 600 psi at the design head.

4. Guides: Minimum material thickness shall be 1/4-inch.

5. Yoke:

a. The yoke shall withstand the thrust of the actuator when a 40-pound effort is placed on the handwheel or handcrank.

b. The requirements Paragraph 1.3.B.5.a above shall be met in addition to a design safety factor of 1.5 with regard to yield strength at the locked-rotor torque of the actuator.

c. The yoke deflection shall not exceed 1/360 of gate width at the maximum operating load.

6. Stem Connection:

a. For manual actuators, the design load shall be the output thrust when a 40 pound effort is applied to the handwheel or handcrank.

b. For an electric actuator, the design load shall be 1.25 times the output thrust developed in the motor-locked rotor torque condition.

7. Stem Guides.

a. Stem guides shall be bushed with a maximum diametral clearance of 1/8.

8. Stem Connection at Slide Plate: Design connection using specified stem sizing criteria.

9. Structural members forming the yoke: Size to accommodate the loads developed by the gate operating device as determined by the stem sizing calculations.

10. Stem Sizing Criteria: Select and provide the largest stem diameter determined by the following calculations:

a. Buckling Load Criteria: The critical buckling load shall be determined using the Euler Column Formula with a C value of 2.

b. Manually operated gates, and gates operated with an electric motor actuator in manual mode: Tensile and Compressive Loads: The tension and compression operating load conditions shall be as follows:

1) Loads created by the application of a 40 pound force on the handwheel or hand crank. Apply a safety factor of 2.0 to tension load calculations.

2) Loads created by a 50 foot-pound torque applied to the operating nut. Apply a safety factor of 2.0 to compressive load calculations.

3) Under both conditions, determine stem diameter that will not exceed one-fifth of the ultimate tensile strength of the stem material.

4) Electrically actuated gates: Determine stem diameters required to a stem design force not less than 1.25 times the output thrust of the unit in the stalled motor condition.

5) Provide stem guides to achieve a slenderness ratio not less 200 for each unsupported section of the stem.

C. Slide gates and weir gates mounted directly to concrete walls: Designed for installation without the use of a wall thimble embedded in the concrete.

D. Guide for stop gates shall be embedded in concrete walls.

E. Allowable Leakage Limits

1. Seating and Unseating Head Installations: Leakage not to exceed 0.10 gallons per minute per foot of seating perimeter for seating and unseating heads.

F. Sizing Criteria for Gate Actuators: In accordance with AWWA C561.

G. Site Conditions

1. The equipment provided under this section shall be specifically designed for operation in a raw sewage channel in a municipal wastewater treatment plant. The wastewater may contain organic solids including vegetable parts, rags, rubber goods, small bits of wood, industrial solvents, petroleum products, grease, and detergents.

H. Exposures

1. Rainfall

2. Wind

3. Direct Sunlight

4. Corrosive environment due to wastewater

a. Partial and complete submergence

b. Splashing

c. Hydrogen sulfide gases

d. Hydrocarbon gases

I. Air temperature: 45 – 85°F

J. Wastewater characteristics

1. Temperature: 45 – 85°F

2. pH: 4 – 12

1.05 QUALITY ASSURANCE

A. Unit Responsibility:

1. Obtain equipment provided under this Section shall from a single supplier or manufacturer who, with the Contractor, shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on equipment furnished regardless of the manufacturing source of that equipment

2. Provide single source coordination responsibility through the manufacturer for the complete system

B. Qualifications

1. For a manufacturer to be determined acceptable for providing the equipment specified herein, they must show evidence of a minimum of ten (10) installations which are successfully in operation for (5) years and ten (10) years' experience in the design and manufacturer of fabricated slide gates in compliance with AWWA C561 of similar size and type as specified herein. Reference information shall include location, service, contact person and contact phone number

2. The equipment shall be a standard production product of the manufacturer.

1.06 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be protected during shipment, handling, and storage as specified in Section 01 66 00.

B. Handle and store in accordance with the manufacturer’s recommendations. Avoid warping gate frame and maintain tolerances between seating faces.

C. Self-contained Slide Gates: Ship as a fully assembled unit, complete and ready for installation, except electric actuators and hydraulic cylinders shall be shipped separately and installed in the field.

D. Ship gates that are not in a self-contained arrangement in components and assemble in the field. Pack gate stems in sturdy wood crates and bolt slide plates and frames securely to wood skids to protect unit and to provide safe handling. Package and ship actuator separately.

1.07 SUBMITTALS

A. Comply with Section 01 33 00.

B. Product Data: Submit manufacturer’s standard catalog data, descriptive literature, parts list, and specifications describing system components.

C. Shop Drawings

1. Certified drawings indicating principal dimensions, general construction of the assembly and materials of construction.

2. Detailed structural, mechanical, and electrical drawings showing equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.

3. Mounting details for each type of mounting configuration used.

4. External utility requirements such as air, water, power, and drain for each component.

5. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.

6. Mounting details and connections to electric gate actuator.

7. Power and control wiring diagrams, including wiring terminal numbers.

8. Contractor's field performance test procedures.

D. Design Data:

1. Gate opening and closing thrust forces that will be transmitted to the support structure with operator at extreme positions and load.

2. Gate operator and stem sizing calculations for each gate and service condition. Show equations used and identify variables and design factors.

3. Calculated gate deflection under maximum specified hydraulic loading condition.

E. Test Reports: Submit results of factory leakage test.

F. Installation Instructions: Submit manufacturer's instructions, requirements, and detailed drawings for installation of slide gates and actuators.

G. Operation and Maintenance Data: Prepare and submit in accordance with Section 01 78 23.

1.08 WARRANTY

A. Provide a manufacturer's warranty meeting the requirements of Section 01 78 36.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following or equal:

1. Golden Harvest, Inc.

2. Fontaine-Aquanox.

3. Hydro Gate LLC.

2.02 MATERIALS

A. Slide, Weir, and Stop Gates Structural Members: Thimble, Frame, Slide Plate, Guides and Yoke: ASTM A240 or ASTM A276, Type 316L Stainless Steel.

B. Lift Nut: ASTM B584 bronze.

C. Flush-Bottom Sill: Extruded or molded neoprene or EPDM. Reclaimed rubber as described in ASTM D2000 shall not be used.

D. Flush-Bottom Sill Retainer: Stainless Steel ASTM A276.

E. Actuator Pedestal: Stainless Steel ASTM A36/A36M.

F. Gear Housing: Cast iron ASTM A48 Grade 35B/40B

G. Gears: Steel, AISI 8620, AISI 4140 or AISI 1117.

H. Thrust Nut

I. Rising Stem Type Slide and Weir Gates: ASTM B584 bronze.

J. Non-rising Stem Type Slide and Weir Gates: ASTM B584 bronze.

K. Seat: UHMWPE in accordance with ASTM D4020

L. Seal: In accordance with AWWA C513.

M. Stems and Stem Couplers: ASTM A276 Type 316 Stainless Steel.

N. Stem Guide Bushings: Cast/Extruded UHMWPE ASTM D4020, or bronze bushed.

O. Bolts, Studs, Fasteners and Anchor Bolts: ASTM A276 Type 316 Stainless Steel. Adhesive anchors per Section 05 50 01.

2.03 FABRICATED SLIDE AND WEIR GATES

A. Designed and fabricated in accordance with AWWA C561.

B. Slide Plate

1. Comprised of a single flat stainless steel plate reinforced as required to meet the specified design criteria for deflection. Horizontal stiffeners to be welded to side vertical stiffeners.

C. Seals

1. Seals shall be self-adjusting UHMWPE with compression cord. Load pads are not acceptable. Elastomeric seals such as J-seals and crown seals and adjustable seal systems are not acceptable.

D. Slide Plate Guides

1. Comprised of structural members welded to form a rigid, one-piece frame designed to mount directly on a concrete wall or within a channel. Bolted together frames are not acceptable.

2. Vertical Guides:

a. Self-contained Gates: Design to extend in one continuous piece from the gate invert to form posts for supporting the yoke. Size vertical guides to retain the slide plate and to withstand forces generated by the gate operating mechanism.

b. Gates not Self-contained: Design to extend in one continuous piece from the gate invert to form posts for supporting at least 2/3 of the slide plate height when the gate is in the full open position. Size vertical guides to retain the slide plate and to withstand forces generated by the gate operating mechanism.

c. Guide Slot Depth: Provide per Manufacturer's recommendations, with the necessary calculations.

d. Guide Slot Liners: Incorporate replaceable UHMWPE bearing strips on both sides of the guide slot.

E. Yoke

1. Formed by structural members welded to the vertical guides.

2. Location Relative to Operating Floor:

a. Minimum Height of Yoke: 3 feet 6 inches above the operating floor.

b. Maximum Height of Yoke: High enough above the operating floor to allow the bottom of the upward acting slide plate to be raised above the maximum water surface elevation when the gate is in the full up position.

F. Stem and Stem Guides

1. Diameter as required to meet specified sizing criteria, minimum 1.5-inch diameter at the threads. Length suitable to extend at least 2 inches above the stop collar when the gate is in the closed position.

2. Rising Stem Gates: Threads shall be machine cut and rolled type, full depth threads with RMS surface roughness of 16 micro-inches or less.

3. Provide adjustable stop collar on manual gates

a. Upward Opening Gates: Located at closed gate position.

b. Downward Opening Gates: Locate to prevent the loss of the slide from the guides.

4. Use stem couplers with internal threads when stems are made up of more than one section. Hold coupler in place with bolts or with key and keyway.

5. Stem Guides: Split, adjustable in two directions to properly align stem.

a. Anchor bolts for stem guide brackets: Type 304/316 stainless steel.

6. Stem Cover:

a. Clear plastic with vent hole, drain and top cap.

b. Place open and closed labels at appropriate locations with adhesive tape and graduations at 1-inch intervals.

2.04 FABRICATED STOP GATES

A. Slide Plate

1. Comprised of a single flat stainless steel plate reinforced as required to meet the specified design criteria for deflection. Horizontal stiffeners to be welded to side vertical stiffeners.

2. Provided with a lifting handle.

3. Provide dual lifting handles on gates wider than 36".

B. Guides

1. Guides shall be designed to be embedded in concrete walls

2. Guide Slot Depth: Provide per Manufacturer's recommendations, with the necessary calculations.

3. Guide Slot Liners: Incorporate replaceable UHMWPE bearing strips on both sides of the guide slot.

4. Gate invert shall contain a removable neoprene seal. Seals attached to the slide will not be acceptable.

2.05 SLIDE AND WEIR GATE OPERATORS

A. Manual Gate Operators: Provide handwheel type operators meeting requirements of AWWA C561 pertaining to manual lifting devices.

1. Handwheel Type Operators: Non-geared.

2. Hand Crank Operators:

a. Geared type designed to allow operation of gate under the specified design hydraulic head condition with a maximum effort of 40 pound pull on the handwheel.

b. Enclose gears and bearings in a weatherproof housing with pressure fittings for grease lubrication.

c. Crank Handles: Removable from the operator.

3. Where top of gate frames are higher than 48" above the operating deck, a mechanism shall be provided to lower the height of the handwheel or hand crank to 36" above the deck.

B. Pedestal Type Floor Stands

1. Off-set type, wall mounted, or standard as indicated on the Drawings.

2. Height: As needed to locate gate operator approximately 36 inches above operating floor.

3. Materials:

a. Floor Stand: Stainless Steel ASTM A36/A36M.

b. Operating Nut: Bronze.

c. Gearing: Steel, accurately machined to provide smooth operation.

d. Operating Nut: Internally threaded with cut or cold rolled Acme threads corresponding to stem threading.

e. Bearings: Grease lubricated ball thrust or tapered, located below and above operating nut to support both opening and closing thrusts.

C. Powered Gate Actuators: In accordance with Section 40 05 57.23.

2.06 FABRICATION

A. Shop Fabrication

1. Workmanship:

a. Conform to design dimensions with bolt holes accurately drilled to match mounting pattern.

b. Free from defects, burrs, grease, and dirt.

2. Tolerances: Within 1/8-inch of square, flatness and dimensional tolerances.

B. Welding: In accordance with AWS D1.6. Welds free of slag, weld splatter and discoloration from heat.

2.07 SOURCE QUALITY CONTROL

1. Tests: Perform leakage test under the specified hydrostatic design conditions. Measure and report leakage.

2. Verification of Operation: Operate slide gate from fully closed to fully open to verify proper operation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Handle, install, connect, clean, condition, and adjust clarifier equipment in strict accordance with manufacturer's instructions and in conformity with specified requirements.

B. Manufacturer's field representative shall inspect the system prior to the beginning of equipment installation, instruct the Contractor on equipment installation, and observe installation. Scheduling and timing of manufacturer's field representative's services is described below

C. Accurately place anchor bolts using the anchor locations shown on the manufacturer's certified drawings.

D. Gate Mounting: Plumb, shimmed as necessary, and accurately aligned.

3.02 START-UP AND FIELD TESTING

A. Inspection, testing, and certification shall be provided, and testing procedures and forms shall be submitted and used, as specified in Section 01 81 00

B. As part of installation testing, described in Section 01 81 00, conduct leakage tests on slide gates when field leakage tests are specified in the Gate Schedule. Subject gates to the design head conditions specified.

C. Manufacturer's field representative shall be present onsite during installation, functional, and operational testing. Scheduling and timing of manufacturer's field representative's services is described below

3.03 TRAINING

A. Manufacturer's field representative shall provide training of the Owner's personnel as described in Section 01 79 00. Scheduling and timing of manufacturer's field representative's services is described below.

3.04 MANUFACTURER'S FIELD SERVICES

A. Manufacturer's field representative services:

B. Inspect the equipment prior to the beginning of equipment installation.

C. Instruct the Contractor on equipment installation.

D. Observe installation.

E. Participate in installation, functional, and operational testing

F. Provide test equipment, tools, and instruments necessary to accomplish equipment testing

G. Provide documentation that equipment has been installed properly, tested properly, and is ready for operation by Owner's personnel, as described in Section 01 81 00

H. Schedule and Timing

1. Schedule site attendance by manufacturer's representative when appropriate based on the progress of the work.

2. Timing: Minimum time spent at the project site, not including travel time:

a. Installation and Testing: Two (2) trips, three (3) days

b. Training: Two (2) sessions, each session one (1) hour

3.05 SCHEDULE

A. The Gate Schedule provided following "End of Section" is part of this Specification.

END OF SECTION

Equipment Number	Qty	Opening Size Width x Height (ft)	Type of Frame	Opening Direction	Mounting Arrangement			Design Head (ft)		Type of Operator	Leakage Testing Requirements		Notes
					Top	Sides	Bottom	Seating	Unseating		Factory	Field	
SLG 110-01	1	3 X 3	SC	U	N/A	WM	C-E	0	20	MO	Yes	Yes	open-close service

Legend
Type of Frame: SC = self-contained, SP = stop-plate guides, NSC = non self-contained
Opening Direction: U = Opens in an upward direction, D = Opens in a downward direction
Frame Mounting Arrangement: WM = Wall Mount, C-S = In-Channel with Surface Mounted Frame, C-E: In-Channel with Embedded Frame
Type of Operator: HW = Handwheel, MO = Electric motor operated

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SECTION 40 05 96

SEISMIC RESTRAINTS FOR PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Seismic restraints for bracing all piping systems specified in Section 40 05 10.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittal Procedures
2. Section 01 61 10 – Seismic Design Requirements
3. Section 01 61 11 – Seismic Anchorage and Bracing
4. Section 05 50 01 – Anchor Bolts and Anchoring Devices
5. Section 40 05 07 – Pipe Hangers and Supports
6. Section 40 05 10 – Piping Systems

1.03 DEFINITIONS

A. Longitudinal Direction: Direction parallel to the pipe axis.

B. Lateral Direction: Direction perpendicular to the pipe axis.

1.04 OPERATING CONDITIONS

A. Provide seismic restraints, specified in this section, to resist pipe movements and loads occurring as a result of an earthquake or other seismic event.

B. Unless otherwise specified, brace all piping to resist seismic loading caused by forces applied at the individual pipe's center of gravity. For seismic loading see Section 01 61 10.

1.05 RESTRAINT SELECTION

A. Unless otherwise specified, select, locate and provide seismic restraints for piping in accordance with the contract documents.

B. Review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the restraint to be used at each point.

C. Seismic restraints may be omitted from the following installations:

1. All other piping less than 2-1/2" inside diameter.
2. All piping suspended by individual hangers 12" or less in length from the top of the pipe to the bottom of the support for the hanger.

D. Do not brace piping systems to dissimilar parts of a building or to dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

E. Size restraints to fit the outside diameter of the pipe, tubing, or, where specified, the outside diameter of insulation.

F. Do not permit contact between a pipe and restraint component of dissimilar metals. Prevent contact between dissimilar metals when restraining copper tubing by the use of copper-plated, rubber, plastic or vinyl coated, or stainless steel restraint components.

G. Do not use branch lines to brace main lines.

H. Do not permit seismic bracing to limit the expansion and contraction of the piping system.

1.06 SUBMITTALS

A. Provide seismic restraint locations, load calculations, and manufacturer's drawings as specified in Paragraph 3.01 as part of the submittals for equipment and piping coordination and installation drawings required in Section 40 05 10.

B. Provide seismic restraint load calculations for each seismically restrained pipe system prepared and signed by a civil or structural engineer currently registered in the State of California. See Section 01 61 11 for seismic loading required.

PART 2 - MANUFACTURERS

2.01 MANUFACTURERS

A. Carpenter & Patterson.

B. B-Line.

C. Kin-Line.

D. Anvil International.

E. Michigan.

F. Pipe Shields Incorporated.

G. Superstrut.

H. Unistrut.

I. Or equal.

2.02 PRODUCTS

A. Materials

1. Restraints, including braces and fittings, pipe and structural attachments, trapeze restraints, and accessories: Type 316 stainless steel.

2. Nuts, bolts and washers, fittings and accessories: Type 316 stainless steel.

3. Comply with MSS SP-58

B. Pipe Attachments

1. Type 1s - Clevis Restraint Attachment

a. Provide Type 1, clevis pipe hanger, as specified in Section 40 05 07, 2.02.B.

2. Type 3s - Double Bolt Restraint Clamp:

   a. Provide Type 3, double bolt pipe clamp, as specified in Section 40 05 07, 2.02.B.

3. Type 4s - Roller Restraint Attachment

   a. Provide Type 4, adjustable roller hanger, as specified in Section 40 05 07, 2.02.B.

   b. Size hold down strap as follows:

      1) 1" through 2" Pipe: 1" by 1/8" thick
      2) 2-1/2" through 4" Pipe: 1-1/4" by 3/l6" thick
      3) 6" Pipe: 2" by 3/l6" thick
      4) 8" Pipe: 2-1/2" by 3/16" thick
      5) 10" through 16" Pipe: 2-1/2" by 1/4" thick
      6) 20" Pipe: 3" by 1/4" thick
      7) 24" Pipe: 3" by 3/8" thick.

4. Type 7s - U-Bolt Restraint

   a. Provide Type 7, U-bolt, as specified in Paragraph 40 05 07, 2.02.B.

5. Type 13s - Framing Channel Strap Restraint

   a. Provide Type 13, framing channel pipe strap, as specified in Paragraph 40 05 07, 2.02.B.

6. Type 14s - Pipe Clamp Restraint

   a. Provide with configuration and components equivalent to MSS and FEDSPEC Type 4.

   b. Rod attachment and longitudinal brace connection stud shall be fabricated and welded by the manufacturer.

   c. Steel pipe (insulated): Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield.

   d. Steel pipe (uninsulated): Superstrut No. S-720, Kin-Line No. S475, or equal.

   e. Cast and ductile iron pipe: Superstrut No. S-720, Kin-Line No. S475, or equal.

   f. Copper pipe (insulated): Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield.

   g. Copper pipe (uninsulated): Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield or dielectric lining.

   h. Plastic pipe: Superstrut No. S-720, Kin-Line No. S475, or equal.

C. Trapeze Restraints

1. General

   a. Unless otherwise specified, provide trapeze members with a minimum steel thickness of 12-gage, with a maximum deflection 1/240 of the span.

2. Type 20s - Single Channel Lateral Restraint

a. Trapeze restraint cross member

1) 1-5/8” square framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, or equal.

b. Pipe attachments

1) Type 13s or Type 7s specified in Paragraph 2.02.B.

c. Rod stiffeners and lateral brace

1) As specified in Paragraph 2.02.D.

3. Type 21s - Double Channel Lateral Restraint

a. Trapeze restraint cross member

1) a double channel manufactured assembly such as Unistrut P1001, B-Line B22A, Superstrut A-1202, or equal.

2) Pipe attachments

a) Type 13s or Type 7s specified in Paragraph 2.02.B.

b. Rod stiffeners and lateral brace

1) As specified in Paragraph 2.02.D.

4. Type 22s - Double Channel Longitudinal Restraint

a. Trapeze restraint cross member: a double channel manufactured assembly such as Unistrut P1001, B-Line B22A, Superstrut A-1202, or equal.

b. Pipe attachments

1) Type 13s or Type 7s specified in Paragraph 2.02.B.

c. Rod stiffeners, longitudinal and lateral braces

1) As specified in Paragraph 2.02.D.

D. Braces and Fittings

1. Seismic Brace Fitting

a. Provided for use with industry standard framing channel.

b. Provide welded construction, two-piece linked fitting.

c. Provide means to reduce noise and vibration transmission between the linked fitting parts.

d. Manufacturers

1) Superstrut C-749N series seismic brace,

2) Kin-Line No. 633 seismic connector fitting,

3) or equal.

2. Hanger Rod Stiffener Assembly

a. Rod stiffener channel

1) 1-5/8” square framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, or equal.

b. Rod stiffener clamps, complete with channel nut

1) Superstrut ES-142, Kin-Line No. 635, or equal.

3. Type A1 Seismic Brace

a. Provide 1-5/8" square framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, Kin-Line No. 4112, or equal.

4. Type A2 Seismic Brace

a. Provide 1-5/8" wide by 3-3/4" deep framing channel, Unistrut P5000, B-Line B11, Superstrut H-1200, Kin-Line No. 8212, or equal.

E. Structural Attachments

1. General

a. Unless otherwise specified, provide hanger rod structural attachments as specified in Section 40 05 07.

b. Structural attachments for longitudinal and lateral seismic braces: as specified in Paragraph 2.02.D.

2. Type SA-1 Attachment

a. Brace fitting: as specified in Paragraph 2.02.D.

b. Concrete anchors

1) As specified in Section 05 50 01 with embedment and location dimensions as specified.

3. Type SA-2 Attachment

a. Brace fitting: as specified in Paragraph 2.02.D.

b. Concrete anchors

1) As specified in Section 05 50 01 with embedment and location dimensions as specified.

c. Framing channel

1) As specified in Paragraph 2.02.F.

4. Type SA-3 Attachment

a. Brace fitting

1) As specified in Paragraph 2.02.D.

b. Cap screw, lockwasher and hex nut materials and finish: compatible with structural steel material.

5. Type SA-4 Attachment

a. Brace fitting

1) As specified in Paragraph 2.02.D.

6. Type SA-5 Attachment

a. Brace fitting

1) As specified in Paragraph 2.02.D.

2) Angle: 4" x 3" x 3/8".

F. Accessories

1. Hanger Rods

a. Threaded on both ends or continuous threaded and sized as specified.

2. Framing Channel

a. Roll formed, 12-gage.

b. Provide channel with a continuous slot along one side with in-turned clamping ridges.

c. Manufacturers

1) Unistrut P1000 series,

2) B-Line B22 series,

3) Superstrut A-1200 series,

4) or equal.

3. Rod Coupling

a. Provide with sight hole in center of coupling body.

b. Manufacturers

1) Anvil International. 135,

2) Superstrut H-119,

3) or equal.

2.03 THERMAL PIPE HANGER SHIELD

A. Provide thermal shields at seismic restraint locations on pipe requiring insulation.

B. Provide thermal pipe hanger shields as specified in Section 40 05 07, 2.03.

C. Provide Type 316 stainless steel band clamps on thermal shields at longitudinal pipe restraint locations.

PART 3 - EXECUTION

3.01 PIPE RESTRAINT LOCATIONS

A. Locate the first seismic restraint on a piping system not more than 10’ from the main riser, entrance to a building or piece of equipment.

B. Brace cast iron pipe on each side of a change in direction of 90º or more. Brace or stabilize joints in risers between floors.

C. Brace no-hub and bell and spigot cast iron soil pipe longitudinally every 20’ and laterally every 10’.

D. Lateral bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 24” of the elbow or tee of the same size.

E. Indicate seismic restraint locations and components on the piping layout drawings required by Section 40 05 10.

F. Provide a legend giving load information and restraint component selection at each restraint location.

G. Provide seismic restraint load calculations conforming to the requirements specified in Paragraph 1.06.

3.02 INSTALLATION

A. Use rod stiffener assemblies at seismic restraints for hanger rods over 6" in length. Provide a minimum of two rod stiffener clamps on any rod stiffener assembly.

B. Install lateral and longitudinal bracing between 45º above and 45º below horizontal, inclusive, relative to the horizontal centerline of the pipe.

C. Construct welded and bolted attachments to the building structural steel which comply with the AISC Manual of Steel Construction. Do not drill or burn holes in the building structural steel without approval of the Construction Manager

D. Use embedded anchor bolts instead of concrete inserts for seismic brace installations in areas below water surface or normally subject to submerging.

E. Install thermal pipe hanger shields on insulated piping at required locations during restraint installation. Make butt joint connections to pipe insulation at the time of insulation installation per the manufacturer's recommendations.

F. Provide restraint components in contact with plastic pipe which are free of burrs and sharp edges.

G. Ensure rollers roll freely without binding.

H. Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 7' above the floor.

END OF SECTION

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SECTION 40 61 93

PROCESS CONTROL INPUT/OUTPUT (I/O)LIST

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Process Control I/O lists for work associated with the system supplier and system integrator scope of work. The system supplier and system integrator scope of work is not under this contract. This is for informational purposes.

1.02 RELATED SECTIONS

A. Division 40 – Process Integration

B. Division 26 – Electrical

1.03 I/O LIST DESCRIPTION AND FORMAT

A. The following is a detailed description of the PLC I/O column descriptions.

B. Column # Column Name Entry Description

1. Number
2. I/O Tag – SCADA ID for I/O Point
3. Description - The tag name assigned to distinguish and identify the specific PLC I/O point.
4. Equipment
5. P & ID Drawing No.
6. I/O Type – Signal Type – Digital or Analog
7. Min – Value of a Setpoint/Range
8. Max – Value of a Setpoint/Range
9. PLC - PLC Name
10. Rack – Rack Location in PLC
11. Slot – Slot Location in PLC
12. Point – Point Location in Slot
13. Comments

PART 2 - PRODUCTS

2.01 I/O SCHEDULE (ATTACHED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

#	I/O Tag	Description	Equipment	P&ID Drawings	I/O Type	Units	Min	Max	PLC	Rack	Slot	Point	Comments
1	YA-300-01	CP-300 120VAC PS1 OK / FAULT STATUS	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	0	
2	YA-300-02	CP-300 120VAC PS2 OK / FAULT STATUS	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	1	
3	YA-300-11	CP-300 24VDC PS1 OK / FAULT STATUS	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	2	
4	YA-300-12	CP-300 24VDC PS2 OK / FAULT STATUS	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	3	
5	YA-300-20A	NIP-300 UPS POWER	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	4	
6	YA-300-20B	NIP-300 UPS LOW BATTERY	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	5	
7	YA-300-20C	NIP-300 UPS COMMON ALARM	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	6	
8	YA-300-30A	CP-300 UPS POWER	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	7	
9	YA-300-30B	CP-300 UPS LOW BATTERY	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	8	
10	YA-300-30C	CP-300 UPS COMMON ALARM	CP-300	N/A	DIGITAL INPUT	N/A	-	-	CP-300	0	1	9	
11	HS-110-00	INFLUENT PS, WET WELL SLUICE GATE IN REMOTE	SLG-110-00	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	
12	XA-110-00	INFLUENT PS, WET WELL SLUICE GATE FAULT	SLG-110-00	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	
13	OC-110-00	INFLUENT PS, WET WELL SLUICE GATE OPEN COMMAND	SLG-110-00	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	
14	CC-110-00	INFLUENT PS, WET WELL SLUICE GATE CLOSE COMMAND	SLG-110-00	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	

#	I/O Tag	Description	Equipment	P&ID Drawings	I/O Type	Units	Min	Max	PLC	Rack	Slot	Point	Comments
15	ZI-110-00	INFLUENT PS, WET WELL SLUICE GATE POSITION FEEDBACK	SLG-110-00	I-111	ETHERNET	%	0	100	NIP-300	0	-	-	
16	MAH-110-01	INFLUENT PS, PUMP NO. 1 SEAL LEAK ALARM	PMP-110-01	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
17	TAH-110-01	INFLUENT PS, PUMP NO. 1 OVERTEMP ALARM	PMP-110-01	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
18	YI-110-01A	INFLUENT PS, PUMP NO. 1 READY	PMP-110-01	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
19	YI-110-01B	INFLUENT PS, PUMP NO. 1 RUNNING	PMP-110-01	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
20	HS-110-01	INFLUENT PS, PUMP NO. 1 IN REMOTE	PMP-110-01	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
21	XA-110-01	INFLUENT PS, PUMP NO. 1 FAULT	PMP-110-01	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
22	YC-110-01	INFLUENT PS, PUMP NO. 1 START COMMAND	PMP-110-01	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
23	SI-110-01	INFLUENT PS, PUMP NO. 1 SPEED FEEDBACK	PMP-110-01	I-111	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
24	SC-110-01	INFLUENT PS, PUMP NO. 1 SPEED CONTROL	PMP-110-01	I-111	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-01 CONTROLLED BY VFD-110-01
25	MAH-110-02	INFLUENT PS, PUMP NO. 2 SEAL LEAK ALARM	PMP-110-02	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02

#	I/O Tag	Description	Equipment	P&ID Drawings	I/O Type	Units	Min	Max	PLC	Rack	Slot	Point	Comments
26	TAH-110-02	INFLUENT PS, PUMP NO. 2 OVERTEMP ALARM	PMP-110-02	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02
27	YI-110-02A	INFLUENT PS, PUMP NO. 2 READY	PMP-110-02	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02
28	YI-110-02B	INFLUENT PS, PUMP NO. 2 RUNNING	PMP-110-02	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02
29	HS-110-02	INFLUENT PS, PUMP NO. 2 IN REMOTE	PMP-110-02	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02
30	XA-110-02	INFLUENT PS, PUMP NO. 2 FAULT	PMP-110-02	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02
31	YC-110-02	INFLUENT PS, PUMP NO. 2 START COMMAND	PMP-110-02	I-111	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02
32	SI-110-02	INFLUENT PS, PUMP NO. 2 SPEED FEEDBACK	PMP-110-02	I-111	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02
33	SC-110-02	INFLUENT PS, PUMP NO. 2 SPEED CONTROL	PMP-110-02	I-111	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-02 CONTROLLED BY VFD-110-02
34	MAH-110-03	INFLUENT PS, PUMP NO. 3 SEAL LEAK ALARM	PMP-110-03	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03
35	TAH-110-03	INFLUENT PS, PUMP NO. 3 OVERTEMP ALARM	PMP-110-03	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03
36	YI-110-03A	INFLUENT PS, PUMP NO. 3 READY	PMP-110-03	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03

#	I/O Tag	Description	Equipment	P&ID Drawings	I/O Type	Units	Min	Max	PLC	Rack	Slot	Point	Comments
37	YI-110-03B	INFLUENT PS, PUMP NO. 3 RUNNING	PMP-110-03	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03
38	HS-110-03	INFLUENT PS, PUMP NO. 3 IN REMOTE	PMP-110-03	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03
39	XA-110-03	INFLUENT PS, PUMP NO. 3 FAULT	PMP-110-03	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03
40	YC-110-03	INFLUENT PS, PUMP NO. 3 START COMMAND	PMP-110-03	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03
41	SI-110-03	INFLUENT PS, PUMP NO. 3 SPEED FEEDBACK	PMP-110-03	I-112	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03
42	SC-110-03	INFLUENT PS, PUMP NO. 3 SPEED CONTROL	PMP-110-03	I-112	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-03 CONTROLLED BY VFD-110-03
43	MAH-110-04	INFLUENT PS, PUMP NO. 4 SEAL LEAK ALARM	PMP-110-04	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04
44	TAH-110-04	INFLUENT PS, PUMP NO. 4 OVERTEMP ALARM	PMP-110-04	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04
45	YI-110-04A	INFLUENT PS, PUMP NO. 4 READY	PMP-110-04	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04
46	YI-110-04B	INFLUENT PS, PUMP NO. 4 RUNNING	PMP-110-04	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04
47	HS-110-04	INFLUENT PS, PUMP NO. 4 IN REMOTE	PMP-110-04	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04

#	I/O Tag	Description	Equipment	P&ID Drawings	I/O Type	Units	Min	Max	PLC	Rack	Slot	Point	Comments
48	XA-110-04	INFLUENT PS, PUMP NO. 4 FAULT	PMP-110-04	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04
49	YC-110-04	INFLUENT PS, PUMP NO. 4 START COMMAND	PMP-110-04	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04
50	SI-110-04	INFLUENT PS, PUMP NO. 4 SPEED FEEDBACK	PMP-110-04	I-112	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04
51	SC-110-04	INFLUENT PS, PUMP NO. 4 SPEED CONTROL	PMP-110-04	I-112	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-04 CONTROLLED BY VFD-110-04
52	MAH-110-05	INFLUENT PS, PUMP NO. 5 SEAL LEAK ALARM	PMP-110-05	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05
53	TAH-110-05	INFLUENT PS, PUMP NO. 5 OVERTEMP ALARM	PMP-110-05	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05
54	YI-110-05A	INFLUENT PS, PUMP NO. 5 READY	PMP-110-05	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05
55	YI-110-05B	INFLUENT PS, PUMP NO. 5 RUNNING	PMP-110-05	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05
56	HS-110-05	INFLUENT PS, PUMP NO. 5 IN REMOTE	PMP-110-05	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05
57	XA-110-05	INFLUENT PS, PUMP NO. 5 FAULT	PMP-110-05	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05
58	YC-110-05	INFLUENT PS, PUMP NO. 5 START COMMAND	PMP-110-05	I-112	ETHERNET	N/A	-	-	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05

#	I/O Tag	Description	Equipment	P&ID Drawings	I/O Type	Units	Min	Max	PLC	Rack	Slot	Point	Comments
59	SI-110-05	INFLUENT PS, PUMP NO. 5 SPEED FEEDBACK	PMP-110-05	I-112	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05
60	SC-110-05	INFLUENT PS, PUMP NO. 5 SPEED CONTROL	PMP-110-05	I-112	ETHERNET	%	0	100	NIP-300	0	-	-	PMP-110-05 CONTROLLED BY VFD-110-05
61	LSH-110-03	INFLUENT PS, WET WELL HIGH LEVEL ALARM	LSH-110-03	I-112	DIGITAL INPUT	FT	XX	-	CP-300	0	1	10	
62	LSHH-110-04	INFLUENT PS, WET WELL HIGH HIGH LEVEL ALARM	LSHH-110-04	I-112	DIGITAL INPUT	FT	XX	-	CP-300	0	1	11	
63	LI-110-05	INFLUENT PS, WET WELL LEVEL	LE/LIT-110-05	I-112	ANALOG INPUT	FT	XX	XX	CP-300	0	6	0	
64	FQ-110-11	12" RAW SEWAGE INFLUENT FLOWMETER FLOW PACE	FE/FIT-110-11	I-112	ETHERNET	GPM	-	XX	NIP-300	0	-	-	
65	FI-110-11	12" RAW SEWAGE INFLUENT FLOWMETER FLOW RATE	FE/FIT-110-11	I-112	ETHERNET	GPM	XX	XX	NIP-300	0	-	-	
66	FQ-110-12	24" RAW SEWAGE INFLUENT FLOWMETER FLOW PACE	FE/FIT-110-11	I-112	ETHERNET	GPM	-	XX	NIP-300	0	-	-	
67	FI-110-12	24" RAW SEWAGE INFLUENT FLOWMETER FLOW RATE	FE/FIT-110-11	I-112	ETHERNET	GPM	XX	XX	NIP-300	0	-	-	

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SECTION 40 61 96.13

PROCESS CONTROL DESCRIPTION – INFLUENT PUMP STATION PUMPS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Instrumentation control loops.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 01 78 23 – Operation and Maintenance Information
3. Section 40 61 13 – Process Control System General Provisions

1.03 QUALITY ASSURANCE

A. See Specification Section 40 61 13.

1.04 SYSTEM DESCRIPTION

A. The control loop descriptions provide the functional requirements of the control loops represented in the Contract Documents.

B. Descriptions are provided as follows:

1. Control system overview and general description.
2. Major equipment to be controlled.
3. Major field mounted instruments (does not include local gages).
4. Manual control functions.
5. Automatic control functions/interlocks.
6. Major indications provided at local control panels and motor starters/VFD's.
7. Remote indications and alarms.

C. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions, but are rather intended to supplement and complement the Drawings and other Specification Sections.

1. The control loop descriptions shall not be considered equal to a bill of materials.

D. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on Drawings.

1.05 SUBMITTALS

A. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Contract Closeout Information:

1. Operation and Maintenance Data:

a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Control Strategy for Record Documents:

1. Obtain this Specification Section in electronic format (Microsoft Word) from Engineer at beginning of Project.

2. Revise and update the file monthly during construction and start-up to reflect all changes that occur due to specific equipment and systems supplied on the Project.

a. Show all revisions in 'track change' mode.

b. Change Specification Section Title to read "Control Loop Descriptions - Contractor Record Document."

c. Reference all changes by Request for Information (RFI) number or Change Proposal Request (CPR) number.

d. Submit revised file monthly to Engineer for review.

D. Deliver the revised and updated file as a final control loop description Record Document in the Operation and Maintenance Manual described in Specification Section 01 78 23.

E. Provide both paper copy and electronic copy (on CD-ROM) of the Record Document control loop descriptions in the Operation and Maintenance Manual described in Specification Section 01 78 23.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.01 CONTROL LOOPS

A. This Section includes control loops for Phase 1. The Phase 1 package that each control loop is associated with is noted below. Programming and other work associated with Phase 1 control loops shall not be included in the bid price for Phase 2.

CONTROL STRATEGY 2 – INFLUENT PUMP STATION PUMPS

1.1 REFERENCES

A. Drawings:
   1. M-110, M-111, M-112, M-113, M-114
   2. E-051, E-110, E-111, E-112, E-113, E-901, E-902, E-903, E-904, E-905, E-906
   3. I-110, I-111

B. Specifications:
   1. Section 40 05 62, Eccentric Plug Valve
   2. Section 40 05 65.23, Swing Check Valves.
   3. Section 40 71 00, Flow Measurement
   4. Section 43 25 02, Submersible Wastewater Pumps Solids Handling

1.2 SYSTEM COMPONENTS

A. Major Mechanical Equipment & Motors
   1. Pumps: PMP-110-01, PMP-110-02, PMP-110-03, PMP-110-04, PMP-110-05
   2. Temperature Switches: TS-110-01, TS-110-02, TS-110-03, TS-110-04, TS-110-05
   3. Moisture Switches: MS-110-01, MS-110-02, MS-110-03, MS-110-04, MS-110-05

B. Level & Flow Instruments
   1. Level Element/Indicator/Transmitter LE/LIT-110-05
   2. Level Switches LSH-110-01, LSHH-110-02, LSH-110-03
   3. Flow Meter and Indicator/Transmitter FE/FIT-110-11, FE/FIT-110-12

C. Other Mechanical Devices:
   1. Air Release Valves ARV-110-01, ARV-110-02, ARV-110-03, ARV-110-04, ARV-110-05

D. Local Control Station with the following:
   1. LOCAL/OFF/REMOTE switches: HS-110-01, HS-110-02, HS-110-03, HS-110-04, HS-110-05
   2. START pushbuttons
   3. STOP pushbuttons
   4. SPEED potentiometer
   5. RUNNING & FAULT indicator lights
   6. FAST STOP pushbutton

E. MCC Devices
   1. VFD-110-01, VFD-110-02, VFD-110-03, VFD-110-04, VFD-110-05

1.3 DESCRIPTION

The Influent Pump Station (IPS) receives raw sewage from the collection system and pumps it into the wastewater treatment plant. The IPS consists of a concrete wet well with five submersible solids handling pumps in it. There are 2 small pumps (PMP-110-01 & PMP-110-02) and 3 large pumps (PMP-110-03, PMP-110-04, & PMP-110-05). Each pump has a VFD and LOCAL/OFF/REMOTE switch. The large pumps discharge into a large force main and the small pumps discharge into a small force main. There is an interconnect between the large and small force mains that can be used during emergencies. Both force mains discharge to the Raw Sewage Screening Facility. The IPS wet well is equipped with a Level Transmitter LE/LIT-110-05 and 2 level float switches (LSH-110-01 at 502.50' and LSHH-110-02 at 503.50') to monitor the water surface elevation in the wet well. Flow meter FE/FIT-110-11 measures the flow rate in the small force main and flow meter FE/FIT-110-12 measures the flow rate in the large force main. The upstream manhole has an overflow float switch LSH-110-03 which shall be adjustable between elevations 503.50 to 517.50.

Normal Automatic Operation

The small pumps shall be configured in a Lead/Lag arrangement. The large pumps shall be configured in a Lead/Lag/Standby arrangement. The pumps should be cycled through the positions (Lead, Lag and Standby) by the PLC based on run time hours to equalize use of all three pumps.

The number of pumps running and the speed of the pumps shall be determined by the water surface level in the pump wet well as described below:

- No Pump Operation:
    - When the water surface elevation in the wet well is below 498.00', the pumps shall be off.
    - If the water surface elevation drops to the low level (497.00') or low-low level (496.25'), an alarm shall be triggered.
    - When the water surface rises above the elevation of 498.50', start 1 Small Pump Operation at low speed.
- 1 Small Pump Operation (Estimated Flow Range of 0.5-1.8 MGD):
    - If the water surface level decreases below the elevation of 498.00' setpoint while the pump is operating at minimum, the pump shall turn off and return to No Pump Operation.
    - The pump speed shall be increased or decreased linearly with the water surface elevation.
    - If the water surface level reaches the elevation of 499.50' while the pump is operating at full speed, switch to 2 Small Pump Operation with both pumps operating at low speed.
- 2 Small Pumps Operation (Estimated Flow Range of 1.8-2.9 MGD):
    - If the water surface level decreases below the elevation of 499.00' while both pumps are operating at low speed, one pump shall turn off and return to 1 Small Pump Operation.
    - Both pumps speeds shall match, increasing or decreasing linearly with the water surface elevation.
    - If the water surface level reaches the elevation of 500.00' while the pumps are operating at high speed, turn off both small pumps and switch to 1 Large Pump Operation at low speed.
- 1 Large Pump Operation (Estimated Flow Range of 2.9-7.2 MGD):
    - If the water surface level decreases below the elevation of 499.50' while the pump is operating at low speed, send an alert to the Operator who will decide whether to remain in 1 Large Pump Operation or return to 2 Small Pump Operation.
    - The pump speed shall be increased or decreased linearly with the water surface elevation.
    - If the water surface level reaches the elevation of 500.50' while the pump is operating at high speed, switch to 2 Large Pump Operation with both pumps operating at low speed.
- 2 Large Pumps Operation (Estimated Flow Range of 7.2-12.4 MGD):
    - If the water surface level decreases below the elevation of 500.00' while both pumps are operating at low speed, one pump shall turn off and return to 1 Large Pump Operation.
    - Both pumps speeds shall match, increasing or decreasing linearly with the water surface elevation.
    - If the water surface level reaches the elevation of 501.50' while the pumps are operating at high speed, send an alert to the Operator who will decide the next mode of operation.
    - If the water surface elevation reaches the high level (502.50') or high-high level (503.50'), an alarm shall be triggered.

Cleaning Cycle

A cleaning cycle shall occur about once a week to clean the wet well. The cleaning cycle will occur in manual mode. The Operator will use the IPS gate to control the water as described in Section 40 61 96.14. The Operator will run Pump PMP-110-05 at the end of the trench until the wet well is almost fully empty and then return to automatic mode.

Level Indicator or PLC Failure

If there is a failure of the Level Indicator or PLC, IPS operations will shift to backup level switch floats LSH-110-01, LSHH-110-02, and timers. The pumps shall be capable of operating independently of either the level sensor or PLC. If the water surface elevation reaches the high level float switch LSH-110-01, one large pumps shall turn on and run on a timer for approximately 4 minutes. If the high-level switch remains activated, the one large pump shall continue to run and shall not turn off at the timed interval. If the water surface elevation reaches the high-high level switch, two large pumps shall turn on and run on a timer for approximately 7 minutes. If the high-high level switch continues to alarm, two large pumps shall continue to run.

1.4 LOCAL MANUAL OPERATION

Local manual operation of the Pumps can be initiated by setting the LOCAL/OFF/REMOTE switch, at the equipment to "LOCAL". The START and STOP pushbuttons and SPEED control dials can then be used to turn pumps on/off. The speed of the pumps may be adjusted manually at the MCC.

1.5 REMOTE MANUAL OPERATION

Remote manual operation of the Pumps can be initiated by setting the LOCAL/OFF/REMOTE switch, at the equipment to "REMOTE". Then, from the Pump Station graphic display screen on the SCADA system, the MANUAL/AUTO selector switch for each piece of equipment should be toggled to MANUAL. The equipment can then be controlled with the controls on the SCADA control screen.

1.6 REMOTE AUTOMATIC OPERATION

Remote automatic operation of the Pumps can be initiated by setting the LOCAL/OFF/REMOTE switch, at the equipment to "REMOTE". Then, from the IPS graphic display screen on the SCADA system, the MANUAL/AUTO selector switch for each piece of equipment should be toggled to AUTO. The equipment will then be controlled automatically as described in Paragraph 1.3.

1.7 SUMMARY OF LOOP FUNCTIONS

A. Refer to the I/O list, P&IDs, and PLC drawings.

1.8 SCADA DISPLAY

A. Pump Start Set Point
B. Pump Stop Set Point
C. Pump Stop All Set Point
D. Pump Designation (LEAD.LAG)
E. Pump Overtemp Alarm
F. Pump Seal Failure Alarm
G. Pump Running Indication
H. Pump Ready Indication
I. Pump Fault Alarm Indication
J. Pump In Local Indication
K. Pump Speed Indication (0 – 100%)

L. Pump VFD Loss of Communication Alarm

M. Wet Well Level Transmitter Level Indication

N. Wet Well Level Transmitter Low Level Indication

O. Wet Well Transmitter High Level Indication

P. Wet Well Level Transmitter Loss of Communication Alarm Indication

Q. Wet Well High Level Float Switch Alarm Indication

R. Wet Well High High Float Switch Alarm Indication

S. Small Force Main Flow

T. Large Force Main Flow

1.9 HISTORICAL TRENDING

A. Wet Well Level

B. Pump Speed for each Pump

C. Run Time Hours for each Pump

D. Flows
   1. Small Force Main
   2. Large Force Main

1.10 ALARMS

A. Pump FAULT – Reset by pressing the VFD fault reset button on the VFD or placing the LOR selector switch at the Local Control Station in the OFF position.

B. Pump OVERTEMP – Reset by pressing the reset button on the motor protection relay at the VFD.

C. Pump SEAL LEAK - Reset by pressing the reset button on the motor protection relay at the VFD.

D. PUMP VFD – LOSS OF COMMUNICATION

E. Level Transmitter HIGH

F. Level Transmitter LOW

G. Level Transmitter LOSS OF COMMUNICATION

H. Wet Well HIGH Level

I. Wet Well HIGH HIGH Level

1.11 INTERLOCKS

A. The HIGH level and HIGH HIGH level float switches are hard wired to the pump VFD.

B. The pump motor protection relay overtempt and seal leak switches are hard wired to the pump VFD.

SECTION 40 61 96.14

PROCESS CONTROL DESCRIPTION – INFLUENT PUMP STATION GATE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Instrumentation control loops.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 01 78 23 – Operation and Maintenance Information
3. Section 40 61 13 – Process Control System General Provisions

1.03 QUALITY ASSURANCE

A. See Specification Section 40 61 13.

1.04 SYSTEM DESCRIPTION

A. The control loop descriptions provide the functional requirements of the control loops represented in the Contract Documents.

B. Descriptions are provided as follows:

1. Control system overview and general description.
2. Major equipment to be controlled.
3. Major field mounted instruments (does not include local gages).
4. Manual control functions.
5. Automatic control functions/interlocks.
6. Major indications provided at local control panels and motor starters/VFD's.
7. Remote indications and alarms.

C. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions, but are rather intended to supplement and complement the Drawings and other Specification Sections.

1. The control loop descriptions shall not be considered equal to a bill of materials.

D. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on Drawings.

1.05 SUBMITTALS

A. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

B. Contract Closeout Information:

1. Operation and Maintenance Data:

a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

C. Control Strategy for Record Documents:

1. Obtain this Specification Section in electronic format (Microsoft Word) from Engineer at beginning of Project.

2. Revise and update the file monthly during construction and start-up to reflect all changes that occur due to specific equipment and systems supplied on the Project.

a. Show all revisions in 'track change' mode.

b. Change Specification Section Title to read "Control Loop Descriptions - Contractor Record Document."

c. Reference all changes by Request for Information (RFI) number or Change Proposal Request (CPR) number.

d. Submit revised file monthly to Engineer for review.

D. Deliver the revised and updated file as a final control loop description Record Document in the Operation and Maintenance Manual described in Specification Section 01 78 23.

E. Provide both paper copy and electronic copy (on CD-ROM) of the Record Document control loop descriptions in the Operation and Maintenance Manual described in Specification Section 01 78 23.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.01 CONTROL LOOPS

A. This Section includes control loops for Phase 1. The Phase 1 package that each control loop is associated with is noted below. Programming and other work associated with Phase 1 control loops shall not be included in the bid price for Phase 2.

CONTROL STRATEGY 1 – INFLUENT PUMP STATION GATE

1.1 REFERENCES

A. Drawings:
   1. M-110, M-111, M-112, M-113, M-114
   2. E-052, E-110, E-111, E-112, E-901, E-902, E-903, E-904
   3. I-110, I-111

B. Specifications:
   1. Section 40 05 59 Hydraulic Gates
   2. Section 40 05 57.23 Powered Valve Operators & Appurtenances

1.2 SYSTEM COMPONENTS

A. Slide Gate: SLG-110-00

B. LOCAL/OFF/REMOTE selector switch: HS-110-00

C. OPEN/CLOSE selector switch: HS-110-00

D. Gate Position Indicator: ZIT 110-00

1.3 DESCRIPTION

The Influent Pump Station (IPS) Gate is located inside the IPS on the wall with the influent pipe. The gate is used to control water entering the IPS.

During normal operation, the gate will be parked in the up position and all flow will be conveyed into the IPS wet well. During IPS cleaning cycles, the gate may need to be partially closed. The gate can also be closed to perform maintenance on the IPS.

The top of the slide gate is at elevation 501.50’ in the closed position. The bottom of the slide gate is at 498.00’ in the closed position. The control algorithm will convert this maximum travel in percent gate open. Specifically, if the gate is at the 0% position (Closed), then this will correspond to the bottom of the gate at elevation 498.00’. Likewise, if the gate is at 100% position (Open), then the bottom of the gate will be at elevation 501.50’. Gate positions between these two endpoints will be in direct linear proportion.

The operator shall be able to set the elevation of the bottom of the slide gate to any percent open or closed.

Any time the gate is closed, there shall be an alarm that warns the operator that the gate is closed.

1.4 LOCAL MANUAL OPERATION

Local manual operation of the IPS Gate can be initiated by setting the LOCAL/OFF/REMOTE switch at the gate actuator to “LOCAL”. The slide gate can then be operated using the OPEN/CLOSE switch at the gate actuator.

1.5 REMOTE MANUAL OPERATION

Remote manual operation of the IPS Gate can be initiated by setting the LOCAL/OFF/REMOTE switch at the gate actuator to “REMOTE.” Then, from the IPS Gate graphic display screen on the SCADA system, the MANUAL/AUTO selector switch for the gate should be toggled to MANUAL. The gate can then be opened, closed, and stopped at any mid-position by using the OPEN, STOP, and CLOSE pushbuttons on the SCADA control screen.

1.6 REMOTE AUTOMATIC OPERATION

Remote automatic operation of the IPS Gate can be initiated by setting the LOCAL/OFF/REMOTE switch at the gate actuator to "REMOTE." Then, from the IPS Gate graphic display screen on the SCADA system, the MANUAL/AUTO selector switch for the gate should be toggled to MANUAL. The gate will then be controlled automatically based on the water surface elevation in the Flow Control Structure as described in Paragraph 1.3.

1.1 SUMMARY OF LOOP FUNCTIONS

A. Refer to the I/O list, P&IDs, and PLC drawings.

1.2 SCADA DISPLAY

A. Gate Position

B. In Remote

C. Fault

D. Open Command

E. Close Command

1.3 ALARMS

A. Gate Closed Alarm

SECTION 40 63 00

CONTROL SYSTEM EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. This section contains the requirements pertaining to the construction and installation of the control panels.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA)
2. National Electrical Installation Standard (NEIS)
   a. 5055, Standard of Installation
3. National Fire Protection Association (NFPA)
   a. 70, National Electrical Code (NEC)
   b. 79, Electrical Standard for Industrial Machinery
4. Underwriters Laboratories, Inc. (UL)
   a. 3121-1, Standard for Safety for Process Control Equipment
   b. 508, Industrial Control Equipment
   c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations
5. National Electrical Manufacturer's Association (NEMA)
   a. 250, Enclosures for Electrical Equipment
   b. ICS 1-2000, Industrial Control and Systems General Requirements

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 40 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 16000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they

are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

E. Shop Drawings

1. Dimensional drawings showing the overall length, width, and height of the assembled control panel. Included on these drawings shall be the back panel layout of installed control devices showing part numbers, dimensions, nameplate text, and other details required for a complete assembly. The CONTRACTOR shall obtain the Drawings for the control panel layout and schematic from the ENGINEER. The CONTRACTOR shall modify the Drawings as required for submittal and for as-built documentation. The CONTRACTOR shall not generate their own drawings.

2. For large control panel, physical properties, handling, mounting, shipping break point locations shall be shown in submittal drawings. This shall include total weight, lifting instructions, height, and floor space required.

3. Provide electrical schematic drawings that include: wiring details such as internal and field connection terminal block numbers; shielded wire termination requirements; grounding requirements; and wire colors. Show all required internal and external interlocking. Each drawing shall be circuit specific for the system submitted. No typical schematic drawings shall be submitted.

4. Drawings shall list the equipment number of the box, control panel, or center submitted.

5. Component designations shall match those shown on the Drawings.

6. Complete bills of materials shall be included with submittal.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Equipment provided as part of this section shall be manufactured by a single licensed firm, regularly engaged in the design and manufacture of such equipment for a minimum of five years. The control panels shall have a UL508A listing. Components within control panels shall be listed in a manner consistent with UL508A requirements.

1.05 MAINTENANCE

A. Manufacturer shall provide and list in the bill of materials the following spare parts.

1. One each of all power and control fuses provided in the assembled control panel/ center.

B. Provide Operation and Maintenance Data and Manuals Pursuant to the Contract Documents.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.01 INSTALLERS

A. All identification labeling shall be in compliance with Section 26 05 53 Identification for Electrical Systems.

B. CONTRACTOR shall install and connect junction boxes and control panels and to field devices as shown on the Drawings.

C. For all conductors terminating on terminal strips, install crimp-on, insulated plastic sleeve ferrules on each wire. Install ferrules with a crimping tool provided by the ferrule manufacturer for that purpose.

D. Individual conductors and cables shall be grouped together and routed through plastic wire ducts mounted on the backpanel surface.

E. Bond each enclosure back-panel to the grounding electrode system with a # 8 AWG copper conductor.

F. Where conductors and cables are routed in boxes or enclosures, they shall be neatly bundled with cable ties at intervals not to exceed 12 inches on center. The tension for the cable ties shall be set with a tool specifically made for this purpose and of the same manufacturer as the cable tie. Side cutters or other type tools shall not be used to cut the tail end of the cable tie. The CONTRACTOR shall only use the tool specifically made for this purpose and designed for use with the cable ties provided.

G. Conduits that enter/exit control system equipment shall be installed on opposite sides of the enclosure to prevent EMF interference and to achieve Code required separation is maintained between power, control and signal conduits. Power conduits shall not be installed in the same location on the enclosure as the control and signal conduits.

3.02 SOURCE QUALITY CONTROL

A. Tests and Inspections

1. CONTRACTOR shall notify the ENGINEER 14 days prior to commencement of shop testing. All equipment shall be tested prior to site delivery.

2. CONTRACTOR-developed test forms shall accompany the notification of testing.

a. Test forms shall list all field connections at terminal strips and all internal logic circuits, along with the method planned for simulation of field conditions to test these connections and circuits.

3. All analog instrument loops shall be tested using an analog signal generator by applying the appropriate control signal to the field termination terminal strip.

a. At a minimum, analog instrument tests shall be made at 0%, 25%, 50%, 75%, and 100% of maximum control signal.

b. Additional analog instrument tests shall be made as appropriate.

4. All digital control circuits shall be tested by: applying the appropriate control voltage to the field termination terminal strip when externally supplied; using a jumper at the field termination terminal strip when internally supplied; or, if applicable, at an internal panel connection point when field terminations are not used.

B. Verification of Performance

1. Device functions shall be observed by the ENGINEER, to determine satisfactory operation of the device and connected circuit continuity, prior to shipment.

3.03 FIELD QUALITY CONTROL

A. Site Tests, Inspection

1. CONTRACTOR shall install, calibrate and test, all systems prior to notifying ENGINEER of witness testing verification.

2. The ENGINEER shall utilize the Process Control Test Certification included in Section 26 01 06 Starting and Adjusting to systematically verify the process control system is operating as designed. The CONTRACTOR shall perform the tasks necessary to confirm proper operation to the ENGINEER.

3.04 UPS

A. The CONTRACTOR shall configure the UPS, 24VDC power supply, and power storage devices using the Quint UPS-CONF software and Quint IFS-USB-DATACABLE. The following software settings shall be set by the CONTRACTOR:

1. System settings:

a. Number of power storage devices (batteries) and model number.

b. 24VDC power supply model number.

2. The UPS trigger thresholds shall be set by the CONTRACTOR as follows:

a. Warning – Battery Low – State of Charge: DISABLED.

b. Warning – Battery Low – Remaining Backup Time: DISABLED.

c. Warning – Battery Low – Battery Voltage: DISABLED.

d. Warning – Battery End of Lifetime – Remaining Life: DISABLED.

e. Alarm - Battery Low – State of Charge: 10%.

f. Alarm – Remaining Backup Time – TWO (2) HOURS.

g. Alarm - Battery Low – Battery Voltage: 20.4 VDC.

h. Alarm - Battery End of Lifetime – Remaining Lifetime: TWO (2) MONTHS.

3. A UPS Battery Alarm (switched 24VDC UPS output) shall consist of any of the following trigger thresholds. These alarms are pre-set by the manufacturer and cannot be changed:

   a. Alarm – Battery Low – State of Charge

   b. Alarm – Battery Low – Remaining Backup Time

   c. Alarm – Battery End of Lifetime – Remaining Life Time

   d. Alarm – Battery End of Lifetime – Quality Criteria

4. A UPS Charging signal (switched 24VDC UPS output) shall be configured by the CONTRACTOR and shall consist of any of the following:

   a. Battery Charging

5. A UPS Battery Mode signal (switched 24VDC UPS output) shall be configured by the CONTRACTOR and shall consist of any of the following:

   a. Battery Mode

B. The power storage devices shall be mounted on individual DIN rails per the Drawings. The power storage devices shall be secured at each end using Heavy Duty End Brackets.

C. The UPS settings shall be downloaded and saved to the UPS memory stick and given to the OWNER.

END OF SECTION

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SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes.

1. This Section contains the basic materials and methods required to install the measurement and control instrumentation system.

1.02 SUBMITTALS

A. Contractor shall submit all the product data in Division 40 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittal.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Insulated Wire Ferrules (407000.F30).

1. Ferrules shall be plastic sleeved and insulated.

2. Ferrules shall be color coded per the DIN Standard.

3. Provide Weidmuller ferrules, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. CONTRACTOR shall install and connect junction boxes, termination boxes, control panels, field devices, etc. as shown on the Drawings.

B. Conductor Terminations.

1. Provide ferrules on all conductors terminating on terminal strips.

2. Ferrules shall be installed with a tool supplied by the ferrule manufacturer design specifically for that purpose.

3. No more than one conductor shall be terminated on each side of a terminal block unless specifically shown otherwise on the Drawings.

C. Terminal Block Jumpers.

1. When connecting adjacent terminal blocks in a terminal strip to provide for common potentials, pre-manufactured bridge type jumpers supplied by the terminal manufacturer shall be used. These jumpers screw into and connect adjacent terminal blocks at the center of the terminal blocks.

2. Comb type jumper shall not be used.

3. Jumpers fabricated from short lengths of wire shall not be used.

D. Twisted Shielded Pair (TSP) Cable Preparation.

1. Strip cable insulation back only to the extent necessary to separate the individual conductors for termination. The shield shall be removed up to the point where the cable insulation has been removed.

2. Provide green heat shrink tubing on the full length of exposed drain wire from the point of termination back to where the cable insulation has been removed. The tubing shall be properly sized for the conductor and shall be shrunk after installation. Reference Section 26 05 83 Wiring Connections for specification requirements for heat shrink tubing.

3. The drain wire shall be grounded as indicated on the Drawings.

4. Provide black heat shrink tubing at the point where the cable insulation has been removed. The tubing shall be 3 inches long and shall extend 1.5 inches up the insulation and 1.5 inches down the individual conductors. The tubing shall be properly sized for the cable and shrunk after installation. No part of the shield and no un-insulated part of the drain wire shall extend beyond this tubing.

Reference Section 26 05 83 Wiring Connections for specification requirements for heat shrink tubing.

E. Equipment Grounding.

1. Each control panel, terminal box and junction box shall have a single grounding point consisting of a grounding bus bar. All grounding conductors terminating within the enclosure shall terminate on the ground bus. The ground bus bar shall be 100 percent copper with 10 percent spare opening for future use. Reference Section 26 05 26 Grounding And Bonding for specification requirements for grounding bus bar.

F. Conductor Splicing.

1. Conductors shall be spliced on terminal blocks installed for this purpose.

2. Conductors shall only be spliced where identified on the Drawings.

3. No other splicing methods shall be approved without prior approval by the ENGINEER.

G. Instrument and Control Device Mounting Brackets.

1. The instrument/control device mounting bracket available from the manufacturer shall be provided and installed as directed unless a detail Drawing indicates a custom mounting bracket shall be provided.

H. Terminal Block and Terminal Strip Identification.

1. Terminal blocks shall be identified as shown on the Drawings. Identification shall be provided on both sides of the terminal block. The plastic identification inserts shall be machine printed and provided by the manufacturer of the terminal blocks.

2. Terminal strips shall be identified as shown on the drawings.

I. Identification

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

3.02 FIELD QUALITY CONTROL

A. Site Tests.

1. Control and instrumentation related conductors shall be tested for resistance to ground through the use of an ohm meter and visual damage to the insulation. Grounded conductors (neutrals and negative conductors) shall be isolated from the grounding system before testing.

2. High voltage “meggers” shall not be used.

3. A conductor shall be replaced if the resistance reading is less than one meg-ohm.

4. CONTRACTOR shall record the results of these tests on the Continuity Test Certification forms and submit them to the ENGINEER as specified in Section 26 01 08 Electrical Testing.

END OF SECTION

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SECTION 40 71 00

FLOW MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. This section includes the requirements pertaining to the measurement and control instruments.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

1. 51.1-1979 - (R1993) - Process Instrumentation Terminology.

2. 5.1-1984 - (R1992) - Instrumentation Symbols and Identification.

B. Instrumentation, Systems, and Automation Society (ISA).

1. 5.3-1983 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.

C. National Fire Protection Association (NFPA) 70 - National Electrical Code.

D. National Electrical Manufacturer's Association (NEMA).

1. 1-2000 - Industrial Control and Systems General Requirements.

E. Underwriters Laboratory (UL).

1. 508 - Industrial Control Equipment.

2. 3121-1 - Standard for Safety for Process Control Equipment.

1.03 DEFINITIONS

A. Manufacturer's Representative - manufacturer's authorized employee of the service division.

1.04 SUBMITTALS

A. Contractor shall submit all the product data in Division 26 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 26000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they

are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

E. Quality Assurance/Control Submittals

1. Manufacturers' instructions for each item specified in PART 2 PRODUCTS.

a. Complete user manual including installation, wiring schematic, programming, calibration, communication, diagnostics, troubleshooting, recommended spare parts, and maintenance recommendations or requirements.

1.05 SEQUENCING

A. CONTRACTOR shall not energize instrumentation until the completion of the continuity test certification and certification of installation by manufacturer's representative.

1.06 SYSTEM START UP, COMMISSIONING, AND OWNER'S TRAINING

A. Pursuant to Section 40 70 00 Instruments for Process Systems

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. <u>Magnetic Flow Meter and Transmitter (407100.F30).</u>

1. Magnetic flow meter shall be provided as shown on the Drawings with a remote transmitter.

2. Provide a pair of ground rings for each meter installation. The ground rings shall be bonded to ground per the meter manufacturer's instructions.

3. Magnetic flow meters shall be FM approved non-incendive Class I, Division 2.

4. The meter body diameter shall be as shown on the Mechanical Drawings.

5. The meter body shall be flanged style with Class 150, A105, carbon steel flanges in accordance with ANSI B16.5.

6. The meter shall be equipped with a remote transmitter rated NEMA 4X and 24-VDC input power. The transmitter shall display instantaneous flow rate and totalized flow. The meter shall be configured to permit the transmission of instantaneous flow rate, and a pulsed output for totalizing flow, all transmitted via Ethernet / IP as shown on the Drawings.

7. Magnetic flow meters shall indicate, totalize, and transmit flow information.

8. Magnetic flow meters shall use pulsed AC measurement technology. Pulsed DC measurement technology is not acceptable.

9. Magnetic flow meters shall include an auto-zero feature.

10. Magnetic flow meters shall compensate for eddy currents.

11. Magnetic flow meters shall be designed for bi-directional measurement of flow in a full pipe with fluid conductivity as low as 5 µS/cm, without preamplifiers.

12. The electromagnetic induction flow meter shall generate a voltage linearly proportional to flow for full-scale velocity settings from one to 33 feet per second. Standard accuracy of the pulse output shall be ±0.5% of rate ±0.05% of full scale (33 ft/s) for all meters.

13. The flow meter shall be equipped with "heartbeat technology" which allows the end user the ability to verify calibration with the equipment left in place with their staff.

14. All components of the flow meter, including meter tube, sensors and recorder/totalizer shall be products of a single manufacturer.

15. Magnetic flow meter flow tubes shall be factory assembled units comprised of a carbon steel spool piece and sensors.

    a. Flow tube flanges shall be carbon steel, conforming to AWWA C110, and shall match the flange style of the piping to which they are connected.

    b. Flow tubes shall be provided with stainless steel retention bolts.

    c. Flow liner shall be polyurethane.

16. Magnetic flow meter sensors shall be solid state design, each with a pair of sensing electrodes, exciter coil, sensor reference coils, and internal grounding electrode.

    a. Magnetic flow meters shall be provided with a minimum of two opposed sensors to distribute the magnetic field over the entire cross-sectional area of the flow tube, and to allow continued operation and flow sensing, with reduced accuracy, in the event of a single sensor failure.

    b. Sensor grounding and sensing electrodes shall be stainless steel.

    c. Sensors shall automatically compensate for media noise including: electrochemical effects; entrained magnetic particles; particulate impact on electrodes; frictional effects against electrodes; variable conductivity; and coated electrodes.

    d. Sensor accuracy shall be unaffected by electrode coatings.

e. The meter shall incorporate a high impedance amplifier of 1012 ohms or greater, eliminating the effect of buildup on the electrodes. The meter shall utilize bipolar pulsed DC coil excitation with automatic coil-current fine tuning by the microcontroller to adjust the sensor current within a tolerance of ±100mA. The amplifier shall incorporate 3-stage signal processing to maintain system accuracy by the use of a 26 bit analog/digital converter. The first stage will adjust the common-mode rejection ratio to filter out noise. The second stage will incorporate an INTEGRATED AUTOZERO function, which compensates for any external interference signals and eliminates zero drift. Manual zero adjustments shall not be required even at start-up. In stage three, the measuring signal will be amplified by an AUTOGAIN function, depending on the actual amplitude of the flow signal, to automatically increase the measurement resolution at various flow rates, providing a turndown of at least 1000:1. To further ensure the specified accuracy, the electronics shall automatically perform internal temperature drift compensation. Power consumption shall be no more than 15 VA, independent of meter size. Upon any power failure, the unit will retain all setup parameters and accumulated measurements internally in non-volatile memory. All units will be protected against voltage spikes from the power source by utilizing internal transient protection.

17. The magnetic flow meter transmitter shall be microprocessor based with integral electronics. The flow meter shall have a 2-line push-button display used for programming as well as for simultaneous display of flow rate and total flow in user-selectable engineering units, and readout of diagnostic error messages, selectable from 12 standard languages. The microprocessor shall safeguard against entering of invalid data for the particular meter size, and all programming parameters shall be access-code protected. The electronics shall include infinitely adjustable low flow cutoff.

    a. Transmitter power supply shall be 24VDC as shown on the Drawings.

    b. Transmitter shall have Ethernet / IP capabilities with an RJ45 connection.

    c. Transmitters shall be shielded or filtered from common RF noise effects including: radio transmissions; variable frequency drives; etc.

    d. Transmitters shall be housed in a corrosion-resistant epoxy painted, cast aluminum, NEMA 4X (IP67) enclosure, suitable for conduit connections, and shall include a clear polycarbonate window to allow viewing of the display without opening the enclosure.

    e. Transmitter operation, configuration, and calibration shall be via the keypad with visual prompts and built-in help at the LCD display.

    f. The flow meter shall have the capability of being programmed remotely using HART/analog protocol.

    g. Transmitter display shall indicate flow rate and/or total flow in user-selectable units of measure.

h. Transmitters shall include:

1) Isolated, independently configurable 4-20 mA analog output. Response time shall be adjustable between 0.05 and 100 seconds.

2) Configurable pulse output for volume units per pulse, or frequency proportional to flow rate. Frequency shall be adjustable up to 10kHZ and pulse width shall be adjustable between 0.05 and 2 seconds.

3) Totalizers for forward, reverse, net, and gross total flow, with user-specified volume units.

4) Independently configurable contact inputs, programmable for measured value suppression, totalizer reset, or error-message reset.

18. The meter shall be provided with a minimum of 0.5% calibration.

19. The tests and the associated documentation will be able to be retained in an electronic format and convertible into a hard copy document compatible for customer review or printing. The technology is commonly referred to by the manufacturer as "Heartbeat Technology". The data format will define all meter settings, ranges, fail-safes, and configuration detail to conform to these requirements. Sensor model, serial number, and test result will be identified for each verification in a date recorded format.

20. The magnetic flow meter shall be an Endress+Hauser Proline Promag W 400 Series, or approved equal.

a.	C6	Approval = CSA C/US NI CI.1 Div.2 gr. U
b.	I	Design = Fixed Flange, 0 x DN Inlet/Outlet Runs
c.	L	Power Supply = 100-240VAC / 24 VAC/DC.
d.	N	Output; Input = Ethernet / IP Connection.
e.	M	Housing = INTEGRAL Transmitter, Compact Polycarbonate.
f.	0	Cable, Remote Version = NOT USED.
g.	D	Electrical Connection = Thread NPT ½ inch.
h.	U	Liner = Polyurethane.
i.	A1K	Process Conn. = 150, carbon steel, flange joint, ASME B16.5
j.	G	Electrodes = 1.4435/316L Bullet Nose.
k.	A	Calibration = 0.5%
l.	AA	Operation Language Display = English
m.	EB	Application Package = Heartbeat Verification + Monitoring

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

2. Field wiring shall be installed according to the Drawings and manufacturer's instructions.

3. Wire and cable shall be connected from terminal to terminal without splices.

4. Wire and cable shall be arranged in a neat manner and securely supported in cable groups.

5. Wiring shall be protected from sharp edges and corners.

6. Float switches shall be installed using a stainless steel type CGB cord grip to seal the end of the conduit.

7. Transmitter connections shall be made using a terminal junction box, analog receptacles, and analog connectors as shown.

8. All equipment to be located as shown, and rigidly attached to walls or floor as shown or directed by Owner's Representative. Install all equipment in strict accordance with manufacturer's recommendations and in compliance with all rules and regulations of jurisdictions having authority. All work to be set plumb or level, as applicable, to be rigid and neat in appearance. Provide shop drawing of equipment and accessory layout and manufacturer's recommendations for installation and accessories before installing.

9. All piping shall be installed as shown on the plans or as directed by Owner's Representative.

10. All piping shall be supported as required to eliminate stresses on equipment including, but not limited to, the feed pump and chlorine tablet feeder.

B. HDPE Mounting Plate

1. HDPE Mounting Plate front edges shall be beveled as indicated on the Drawings to eliminate sharp edges.

3.02 ADJUSTING

A. The representative shall check the installation and supervise initial startup of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily

B. The overall accuracy of each instrumentation system or loop shall be as indicated in the specification for that system or loop. Each individual instrument shall have a minimum accuracy of ±0.5 percent of full scale and a minimum repeatability of ±0.25 percent of full scale unless otherwise indicated.

C. The Contractor shall furnish a representative of the manufacturer to perform inspection, startup and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.

D. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the City's personnel in the proper operation and maintenance of the equipment.

END OF SECTION

SECTION 40 72 00

LEVEL MEASUREMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. This section includes the requirements pertaining to the level measurement and control instruments.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

1. 51.1-1979 - (R1993) - Process Instrumentation Terminology.

2. 5.1-1984 - (R1992) - Instrumentation Symbols and Identification.

B. Instrumentation, Systems, and Automation Society (ISA).

1. 5.3-1983 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.

C. National Fire Protection Association (NFPA) 70 - National Electrical Code.

D. National Electrical Manufacturer's Association (NEMA).

1. 1-2000 - Industrial Control and Systems General Requirements.

E. Underwriters Laboratory (UL).

1. 508 - Industrial Control Equipment.

2. 3121-1 - Standard for Safety for Process Control Equipment.

1.03 DEFINITIONS

A. Manufacturer's Representative - manufacturer's authorized employee of the service division.

1.04 SUBMITTALS

A. Contractor shall submit all the product data in Division 40 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.

2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 26000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they

are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

E. Quality Assurance/Control Submittals

1. Manufacturers' instructions for each item specified in PART 2 PRODUCTS.

a. Complete user manual including installation, wiring schematic, programming, calibration, communication, diagnostics, troubleshooting, recommended spare parts, and maintenance recommendations or requirements.

1.05 SEQUENCING

A. CONTRACTOR shall not energize instrumentation until the completion of the continuity test certification and certification of installation by manufacturer's representative.

1.06 SYSTEM START UP, COMMISSIONING, AND OWNER'S TRAINING

A. Pursuant to Section 40 80 00 Commissioning of Process Systems.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Submerged Hydrostatic Level Transducer (407200.L20).

1. Submerged hydrostatic level element shall be provided as shown on the Drawings.

2. Submerged hydrostatic level element shall be 24 VDC, loop powered.

3. CONTRACTOR shall determine correct sensor cable length based on installation requirements.

4. Submerged hydrostatic level element shall consist of variable capacitance, gauge pressure sensing assembly enclosed in submersible type 316 stainless steel housing with aluminum oxide ceramic sensor.

5. CONTRACTOR shall determine correct sensor range based on installation requirements.

6. Submerged hydrostatic level element seals shall be EPDM.

7. Submerged hydrostatic level element cables shall be mounted with cable-mounting screw.

8. Submerged hydrostatic level elements shall include a vented capillary tube that is protected from moisture intrusion by a Gore-Tex filter. The filter shall be located in the IP66/67 terminal box provided with the transmitter.

9. Submerged hydrostatic level element signal output shall be analog with flexible scaling of 4-20 mA HART in proportion to level.

10. The accuracy shall be ± 0.2% of the set span including hysteresis and non-repeatability; Long-term stability: ±0.1% of Upper Range Limit (URL) per year and must be capable of platinum accuracy of ± 0.1% of the set span.

11. Provide intrinsically safe barrier / relay as required.

12. Provide Endress & Hauser Waterpilot FMX21 transmitter model FMX21-CD-2-1-1K-G-E-25-A-PO-PU, or approved equal.

    a. CD Approval = CSA Class I, Div. 1, Grade A-D

    b. 2 Output; Input = 4-20mA HART

    c. 1 Probe Tube = 316L, d=0.87in

    d. 1K Sensor Range = CONTRACTOR shall determine correct sensor range based on installation requirements.

    e. G Reference Accuracy = Platinum.

    f. E Calibration = inH2O/ftH2O

    g. 25 Probe Connection = Shortable, PE cable. CONTRACTOR to determine lengths.

    h. A Seal = FKM Viton

    i. PO Accessory Enclosed = Suspension Clamp

    j. PU Accessory Enclosed = Additional Weight, 316L

B. Non-Mercury Float Switch (407200.L50).

1. Non-mercury float switches shall be provided as shown on the Drawings.

2. Non-mercury float switches shall be designed for use in drinking water applications.

3. Non-mercury float switches shall be designed as an assembled unit incorporating a float body, snap-action SPDT microswitch, mechanical activation mechanism, cable, and protective strain relief.

4. Non-mercury float switches shall be direct acting.

5. Non-mercury float switches shall be rated for 250V/10A AC and 30V/5A DC.

6. Non-mercury float switch bodies shall be constructed from welded polypropylene. Adhesively assembled float switch bodies are not acceptable.

7. Non-mercury float switch bodies shall be 4” in diameter, minimum.

8. Non-mercury float switches shall include a 60 foot length cable.

9. Non-mercury float switches cables shall be multi-stranded, 3 conductor, 19 gauge, CPE jacketed cable.

10. Non-mercury float switches shall include an EPDM rubber protective sleeve to provide cable strain relief.

11. Provide Gems Sensors, Dwyer, Anchor Scientific, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

2. Field wiring shall be installed according to the Drawings and manufacturer’s instructions.

3. Wire and cable shall be connected from terminal to terminal without splices.

4. Wire and cable shall be arranged in a neat manner and securely supported in cable groups.

5. Wiring shall be protected from sharp edges and corners.

6. Float switches shall be installed using a stainless steel type CGB cord grip to seal the end of the conduit.

7. Transmitter connections shall be made using a terminal junction box, analog receptacles, and analog connectors as shown.

8. All equipment to be located as shown, and rigidly attached to walls or floor as shown or directed by Owner’s Representative. Install all equipment in strict accordance with manufacturer's recommendations and in compliance with all rules and regulations of jurisdictions having authority. All work to be set plumb or level, as applicable, to be rigid and neat in appearance. Provide shop drawing of equipment and accessory layout and manufacturer’s recommendations for installation and accessories before installing.

9. All piping shall be installed as shown on the plans or as directed by Owner’s Representative.

10. All piping shall be supported as required to eliminate stresses on equipment including, but not limited to, the feed pump and chlorine tablet feeder.

3.02 SLACK CABLE FOR INSTRUMENTS IN WET WELLS

A. Provide all sensors, switches, and transducers with excess cable to allow the probes to be lowered to the bottom of the wetwell as required to test probe operation by manually lowering to the water level.

3.03 ADJUSTING

A. The representative shall check the installation and supervise initial startup of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily. In the case of the graphic data manager, the manufacturer's representative shall configure the device for downloading data to a Compatible USB memory stick (thumb drive) and assist the OWNER's staff in loading the Read Win PC 2000 software and the integration with the OWNER's existing MS Excel software for downloading spreadsheets to record flow measurements on a daily, weekly, monthly and annual basis.

B. The overall accuracy of each instrumentation system or loop shall be as indicated in the specification for that system or loop. Each individual instrument shall have a minimum accuracy of ±0.5 percent of full scale and a minimum repeatability of ±0.25 percent of full scale unless otherwise indicated.

C. The Contractor shall furnish a representative of the manufacturer to perform inspection, startup and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment.

D. The representative shall check the installation and supervise initial startup of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily.

E. The representative shall check the installation and supervise initial startup of the equipment. He shall certify that the installation is correct and that the equipment has operated satisfactorily. In the case of the graphic data manager, the manufacturer's representative shall configure the device for downloading data to a Compatible USB memory stick (thumb drive) and assist the OWNER's staff in loading the Read Win PC 2000 software and the integration with the OWNER's existing MS Excel software for downloading spreadsheets to record flow measurements on a daily, weekly, monthly and annual basis.

F. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the City's personnel in the proper operation and maintenance of the equipment.

END OF SECTION

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SECTION 40 78 00

PANEL MOUNTED EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. This section contains the requirements pertaining to the construction and installation of the control panels.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA)
2. National Electrical Installation Standard (NEIS)
   a. 5055, Standard of Installation
3. National Fire Protection Association (NFPA)
   a. 70, National Electrical Code (NEC)
   b. 79, Electrical Standard for Industrial Machinery
4. Underwriters Laboratories, Inc. (UL)
   a. 3121-1, Standard for Safety for Process Control Equipment
   b. 508, Industrial Control Equipment
   c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations
5. National Electrical Manufacturer's Association (NEMA)
   a. 250, Enclosures for Electrical Equipment
   b. ICS 1-2000, Industrial Control and Systems General Requirements

1.03 SUBMITTALS

A. Contractor shall submit all the product data in Division 40 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they

are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

E. Shop Drawings

1. Dimensional drawings showing the overall length, width, and height of the assembled control panel. Included on these drawings shall be the back panel layout of installed control devices showing part numbers, dimensions, nameplate text, and other details required for a complete assembly. The CONTRACTOR shall obtain the Drawings for the control panel layout and schematic from the ENGINEER. The CONTRACTOR shall modify the Drawings as required for submittal and for as-built documentation. The CONTRACTOR shall not generate their own drawings.

2. For large control panel, physical properties, handling, mounting, shipping break point locations shall be shown in submittal drawings. This shall include total weight, lifting instructions, height, and floor space required.

3. Provide electrical schematic drawings that include: wiring details such as internal and field connection terminal block numbers; shielded wire termination requirements; grounding requirements; and wire colors. Show all required internal and external interlocking. Each drawing shall be circuit specific for the system submitted. No typical schematic drawings shall be submitted.

4. Drawings shall list the equipment number of the box, control panel, or center submitted.

5. Component designations shall match those shown on the Drawings.

6. Complete bills of materials shall be included with submittal.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Equipment provided as part of this section shall be manufactured by a single licensed firm, regularly engaged in the design and manufacture of such equipment for a minimum of five years. The control panels shall have a UL508A listing. Components within control panels shall be listed in a manner consistent with UL508A requirements.

1.05 MAINTENANCE

A. Manufacturer shall provide and list in the bill of materials the following spare parts.

1. One each of all power and control fuses provided in the assembled control panel/ center.

B. Provide Operation and Maintenance Data and Manuals Pursuant to the Contract Documents.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Stainless Steel, NEMA 4X Enclosures (407800.E01).

1. Enclosures shall be provided as shown on the Drawings.

2. Enclosures shall be provided with accessories as shown on the Drawings and as specified below.

3. Enclosures in damp, wet, corrosive, or outdoor locations shall be: constructed of stainless steel (NEMA 4X) with zinc electroplated (galvanized) steel back-panel; continuous hinged with gasketed doors and screw down clamps.

4. Provide manufacturer supplied swing-out deadfront door within the enclosure.

5. Enclosures in outdoor locations shall be equipped with a hasp and staple for padlocking.

6. Provide Hoffman enclosures, or approved equal.

B. Panel Vents (407800.V01).

1. Panel Vents shall be provided as shown on the Drawings.

2. Provide Hoffman number ANMV3, or approved equal.

C. Enclosure Heater (407800.H17).

1. Enclosure heaters shall be provided as shown on the Drawings.

2. Enclosure heaters shall operate on 115 VAC.

3. Enclosure heaters shall be provided with integral mounted thermostats.

4. For 100W heaters, provide Hoffman model DAH1001A, or approved equal.

5. For 200W heaters, provide Hoffman model DAH2001A, or approved equal.

D. Miniature “Ice Cube” Relays (24 VDC) (407800.R05).

1. Provide relays as shown on Drawings.
2. Relays shall be industrial plug-in blade style with the on/off status indicated by either a neon or LED indicating light or by mechanical means.
3. Relays shall be Form C contacts with a minimum of 4 poles and 7-amp contact rating.
4. Relay coil voltage shall be 24VAC.
5. Provide with DIN rail mounting screw terminal socket and retainer clips.
6. Relay bases shall be of the same manufacturer as the relay.
7. Provide Allen-Bradley p/n 700-HC24A24 relays, p/n 700-HN104 screw terminal sockets, and p/n 700-HN114 retainer clips, or approved equal.

E. Time Delay Relays (407800.R12).

1. Time delay relays shall be provided as shown on the Drawings.
2. Time delay relays shall be either time delay on energize (TDOE), or time delay on de-energize (TDODE) as indicated on the Drawings.
3. Time delay relays shall be provided with a timing range as indicated on the Drawings.
4. Time delay relays shall be industrial plug-in blade style.
5. Time delay relays shall indicate the timed out status by either a neon indicating light, LED indicating light, or by mechanical means.
6. Time delay relays shall be provided with a minimum of three Form C contacts, and 10 Amp contact rating.
7. Time delay relay coil voltage shall be either 120 VAC or 24 VDC as indicated on the Drawings.
8. Time delay relays shall be provided with DIN rail mounting bases and hold down clips.
    a. Relay bases shall be of the same manufacturer as the relay.
9. Provide Idec RTE Series, or approved equal.

F. Control Fuses (407800.F01).

1. Control Fuses shall be provided as shown on the Drawings.
2. Control Fuses shall interrupt and isolate electrical power to individual control circuits and components within each enclosure and for circuits and components located outside each enclosure but deriving power from the enclosure.
3. Control Fuses shall be rated at 250 VAC minimum and with current ratings as shown on the Drawings.
4. Control Fuses shall have fast acting and time delay characteristics as dictated by the connected load.

5. Provide five (5) spare fuses of each type and size provided for each control panel.

6. Provide Ferraz-Shawmut type GGM, or approved equal.

G. Selector Switches (407800.S01).

1. Selector switches shall be provided as shown on the drawings.

2. Selector switches shall be of round construction with rotary operators.

3. Selector switches operation shall be to maintain the position turned to unless shown otherwise on the Drawings.

4. Selector switches shall be provided with the number of contacts, switch positions, and other details as shown on the Drawings.

5. Selector switches shall be rated NEMA 13 for indoor applications and NEMA 4 for outdoor applications.

6. Selector switch contacts shall be rated at 10 Amps.

7. Provide Allen-Bradley Bulletin 800T pilot devices (30mm, NEMA Type 4/4X/13), or approved equal.

H. Pushbutton Switch (407800.S02).

1. Pushbutton switches shall be provided as shown on the drawings.

2. Pushbutton switches shall be of round construction with push or push-pull operators.

3. Pushbutton switch operation shall be momentary or maintained as shown on the Drawings.

4. Pushbutton switches shall be provided with the number of contacts, switch positions, and other details as shown on the Drawings.

5. Pushbutton switches shall be rated NEMA 13 for indoor applications and NEMA 4X for outdoor applications.

6. Pushbutton switch contacts shall be rated at 10 Amps.

7. Provide Allen-Bradley Bulletin 800T pilot devices (30mm, NEMA Type 4/4X/13), or approved equal.

I. Key Switches (407800.S03).

1. Key switches shall be provided as shown on the drawings.

2. Key switches shall be of round construction with rotary operators.

3. Key switches operation shall be to maintain the position turned to unless shown otherwise on the Drawings.

4. Key switches shall be provided with the number of contacts, switch positions, and other details as shown on the Drawings.

5. Key switches shall be rated NEMA 13 for indoor applications and NEMA 4X for outdoor applications.

6. Key switch contacts shall be rated at 10 Amps.

7. Provide Allen-Bradley Bulletin 800T pilot devices (30mm, NEMA Type 4/4X/13), or approved equal.

J. Mushroom Style Pushbutton Switch (407800.S04).

1. Mushroom Style Pushbutton switches shall be provided as shown on the drawings.
2. Mushroom Style Pushbutton switches shall be of round construction with push or push-pull operators.
3. Mushroom Style Pushbutton switch operation shall be momentary or maintained as shown on the Drawings.
4. Mushroom Style Pushbutton switches shall be provided with the number of contacts, switch positions, and other details as shown on the Drawings.
5. Mushroom Style Pushbutton switches shall be rated NEMA 13 for indoor applications and NEMA 4X for outdoor applications.
6. Mushroom Style Pushbutton switch contacts shall be rated at 10 Amps.
7. Mushroom Style Pushbutton switches for Emergency Stop and other emergency switches (e.g., Help Me switches) shall be: provided with a red mushroom head; pull to reset; provided with N/C (failsafe) contacts; and shall be non-illuminated.
8. Provide Allen-Bradley Bulletin 800T pilot devices (30mm, NEMA Type 4/4X/13), or approved equal.

K. Indicator Lights (407800.L20).

1. Indicator lights shall be provided as shown on the drawings.
2. Indicator lights shall be of round construction.
3. Indicator lights shall have a built in push-to-test function.
4. Indicator light operation shall be as shown on the Drawings.
5. Indicator light lens colors shall be as shown on the Drawings.
6. Indicator lights shall be provided with high visibility LED lamps with transformers for circuit voltages over 24 VAC/DC, and high visibility LED lamps without transformers for circuits 24 VAC/DC and below.
7. Indicating lights shall be rated as NEMA 13 for indoor applications and NEMA 4X for outdoor applications.
8. Indicator light contacts shall be rated at 10 Amps.
9. Provide Allen-Bradley Bulletin 800T pilot devices (30mm, NEMA Type 4/4X/13), or approved equal.

L. Speed Setpoint Potentiometer (407800.P20).

1. Speed potentiometers shall be provided as shown on the Drawings.
2. Speed potentiometers shall be of round construction.
3. Speed potentiometers operation shall be as shown on the Drawings.

4. Speed potentiometers shall be 10k-ohm.

5. Provide Allen-Bradley 800H-UR29, or approved equal.

M. Terminal Strip Identification Block (407800.T15).

1. Provide a terminal strip identification block with a machine generated label to match those shown on the Drawings.

2. Provide a Phoenix Contact marker carrier model number UBE/D, or approved equal.

N. Low Current Terminal Blocks (407800.T10).

1. Low current terminal blocks shall be provided as shown on the Drawings and in all panels requiring low current field terminations. Provide accessories as required and as shown including, but not limited to end anchors, end barriers, bridge jumpers, terminal strip pre-printed markers and snap-in pre-printed terminal block markers.

2. Low current terminal blocks shall be used for electrical circuits rated at or less than 30 amps.

3. Low current terminal blocks shall mount on DIN rail.

4. Low current terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.

5. Low current terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.

6. Low current terminal blocks shall be grey in color.

7. Low current terminal blocks shall be UL rated for up to 30 amps at 600 VAC.

8. Low current terminal blocks shall accept wires from 24 to 10 AWG for single conductor per termination.

9. Provide Phoenix Contact model UK5N, or approved equal.

O. Grounding Terminal Blocks (407800.T60).

1. Grounding terminal blocks shall be provided as shown on the Drawings and in all panels requiring field terminations.

2. Grounding terminal blocks shall be used for electrical circuits rated at or less than 30 amps.

3. Grounding terminal blocks shall mount on DIN rail.

4. Grounding terminal blocks shall be UL rated for a maximum of 30 amps and 600 VAC and to accept wires from 26 to 10 AWG for single conductor per termination.

5. Grounding terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.

6. Low current terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.

7. Grounding terminal blocks shall be green / yellow in color.

8. Provide Phoenix Contact model USLKG5, or approved equal.

P. Fusible DC Terminal Blocks (407800.T30).

1. Fusible DC terminal blocks shall be provided for 24 VDC control circuits as shown on the Drawings.
2. Fusible DC terminal blocks shall be rated for use in electrical control circuits rated 6.3 amps or less and 15-30 VAC/DC.
3. Fusible DC terminal blocks shall mount on DIN rail.
4. Fusible DC terminal blocks shall accept 5 mm by 20, 25 or 30 mm fuses and use LED type blown fuse indicators.
5. Fusible DC terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
6. Fusible DC terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
7. Fusible DC terminal blocks shall be black in color.
8. Provide Phoenix Contact model UK5 HESILED 24, or approved equal.

Q. Fusible AC Terminal Blocks (407800.T35).

1. Fusible AC terminal blocks shall be provided for 120 VAC control circuits as shown on the Drawings.
2. Fusible AC terminal blocks shall be rated for use in electrical control circuits rated 6.3 amps or less and 110-250 VAC/DC.
3. Fusible AC terminal blocks shall mount on DIN rail.
4. Fusible terminal blocks shall accept 5 mm by 20, 25 or 30 mm fuses and use neon blown fuse indicators.
5. Fusible AC terminal blocks shall be supplied with all required accessories including end covers, fixed bridge bars, partition plates and end brackets.
6. Fusible AC terminal blocks shall be supplied with machine printed terminal block and terminal strip identification numbers that match the approved submittals.
7. Fusible AC terminal blocks shall be black in color.
8. Provide Phoenix Contact model UK5 HESILA 250, or approved equal.

R. Wire Identification Labels (407800.L02).

1. Wire identification labels shall be provided for all conductors within control panels and control centers.
2. Wire identification labels shall be machine printed, non-adhesive, wire marker heat shrink sleeves with identification numbers that match the approved submittals.
3. Wire identification labels shall be properly sized for the conductor or cable and shall be white with black characters.

4. Provide Brady, Panduit, or approved equal.

S. Narrow Slot Wire Ducts (Narrow Slot) (407800.W21).

1. Wire ducts shall be provided as shown on the Drawings.
2. Wire ducts shall be large enough to provide a wire fill area no more than 40 percent of the total cross sectional area of the wire ducts.
3. Wire ducts shall be attached to the back panel with screws or plastic fasteners that are approved for use with, and provided by the wire duct manufacturer.
4. Wire ducts shall not be attached to back panel or enclosure side surfaces with glue, tape, or other such adhesives.
5. Wire ducts shall be white in color.
6. Wire ducts shall have slotted sides.
7. Wire ducts shall be provided with removable covers.
8. Provide Panduit Type F, Thomas & Betts Type NPW, or approved equal.

T. Noise Shield (407800.N20).

1. Noise shields shall be provided as shown on the Drawings.
2. Noise shields shall be designed to provide up to 20 dB reduction in noise, equivalent to six-inch air spacing.
3. Noise shields shall be provided with bonding clips to allow mounting inside wire ducts.
4. Noise shield height shall match the wire duct height.
5. Noise shields shall be perforated and pre-scored.
6. Noise shields shall include vertical wall slots and horizontal cable tie slots.
7. Noise shields shall be zinc plated on all horizontal (contact) surfaces and black powder coated on all vertical surfaces.
8. Noise shields shall be attached to the backpanel with screws or plastic fasteners that are approved for the use and provided by the wire duct manufacturer.
9. Provide Panduit model SD(_)EMI, or approved equal.

U. Spiral Wrap (407800.W30).

1. Spiral wrap shall be provided as shown on the Drawings and for all conductor and cable wire assemblies that cross hinged connections.
2. Spiral wrap shall be sized per the manufacturer's instructions.
3. Spiral wrapped assemblies shall include a strain relieving loop at each hinge crossing, with a minimum 6 inch vertical height, to minimize flexing of the wires in the conductor and cable assemblies.
4. Provide Panduit, Thomas & Betts, or approved equal.

V. Cable Ties (407800.W40).

1. Cable Ties shall be provided as required for organizing and arranging conductors within boxes, control panels, and control centers.
2. Cable ties shall be UV resistant.
3. Cable ties shall be black in color.
4. Cable ties shall be installed using a tool from the cable tie manufacturer and specifically intended for use with the cable ties provided.
5. Provide Panduit, Thomas & Betts, or approved equal.

W. DIN Mounting Rail (407800.D10).

1. DIN Mounting Rail shall be provided as shown on the Drawings and in all panels requiring DIN mounting rail.
2. DIN mounting rails shall be made of steel, galvanized, and yellow chromated.
3. Provide Phoenix Contact model NS 35/7.5, Allen-Bradley model 199-DR1, or approved equal.

X. Ground Bars (407800.G06).

1. Ground bars shall be provided as shown on the Drawings.
2. Ground bars shall be low profile, "bus" type with set screw or pressure type connections and all copper construction.
3. Ground bars shall include sufficient termination points to accommodate all equipment grounding conductors as shown on the Drawings.
4. Ground bars shall include spare termination points to accommodate twenty (20) additional conductors sized, #14 through #8 AWG.
5. Provide Cutler-Hammer model GBK21, GE model TGK42, Square D model PK27GTA, or approved equal.

Y. Heavy Duty End Bracket (407800.A61).

1. Provide heavy duty end brackets on DIN rails as indicated on the Drawings.
2. Heavy duty end brackets shall be suitable for 35 mm DIN rails.
3. End brackets shall be screw-on style.
4. Provide Phoenix E/AL-NS 35 series or approved equal.

Z. Intrinsically Safe Relay (407800.R90).

1. Intrinsically safe relay shall be a signal conditioner used for transfer of binary switching signals from a hazardous area.
2. The input circuit shall be monitored for line faults (breakage and short circuit (LFD)).
3. Errors on the intrinsically safe relay shall be indicated by a red flashing LED and the output shall switch to a high-impedance state.
4. Intrinsically safe relay shall be single (1) channel.
5. Provide Phoenix, PR Electronics, Allen Bradley, or approved equal.

AA. Intrinsically Safe HART Barrier (407800.B90).

1. Intrinsically safe HART barrier shall be a repeater power supply and input isolating amplifier. The repeater power supply and input signal conditioner shall be designed for the intrinsically safe and electrically isolated operation of measuring transducers and mA current sources installed in the hazardous areas.
2. Intrinsically safe barrier shall be capable of supplying power to 2-wire transducers.
3. Intrinsically safe barrier shall be capable of operating and measuring 4-wire transducers via a non-powered input.
4. The analog measured value on the intrinsically safe or non-intrinsically safe side shall be capable of overlaying a digital (HART) communication signal and transmit bidirectionally.
5. Intrinsically safe HART Barrier shall be single (1) channel.
6. Provide Phoenix, PR Electronics, Allen Bradley, or approved equal.

BB. Category 6 Ethernet Patch Cable (407800.C90).

1. Category 6 Ethernet patch cable shall be provided for all Ethernet/IP networked devices.
2. Category 6 Ethernet patch cable shall be suitable for use as Industrial Ethernet Cable, 100BaseTX.
3. Category 6 Ethernet patch cable shall be rated for use in a temperature range between -10 degrees C and 60 degrees C.
4. Category 6 Ethernet patch cable shall be rated for outdoor use.
5. Category 6 Ethernet patch cable shall be rated for 300 volts maximum.
6. Category 6 Ethernet patch cable conductors shall be 4-pair, solid copper, 24 AWG.
7. Category Ethernet patch cable conductor pairs shall be bonded.
8. Category 6 Ethernet patch cable insulation material shall be Polyolefin.
9. Category 6 Ethernet patch cable insulation color shall be blue.
10. Category 6 Ethernet patch cable shall be provided with aluminum foil polyester tape shield with 100% insulation coverage.
11. Category 6 Ethernet patch cable outer jacket material shall be PVC. Jacket material shall be sunlight and oil resistant. Jacket shall have sequential markings at two foot intervals.
12. Category 6 Ethernet patch cable shall be provided with RJ45 plugs, suitable for IP20 applications.
13. Category Ethernet patch cable shall be Belden Data Tuff Industrial Ethernet Cord Set E505 Series, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLERS

A. All identification labeling shall be in compliance with Section 26 05 53 Identification For Electrical Systems.

B. CONTRACTOR shall install and connect junction boxes and control panels and to field devices as shown on the Drawings.

C. For all conductors terminating on terminal strips, install crimp-on, insulated plastic sleeve ferrules on each wire. Install ferrules with a crimping tool provided by the ferrule manufacturer for that purpose.

D. Individual conductors and cables shall be grouped together and routed through plastic wire ducts mounted on the backpanel surface.

E. Bond each enclosure back-panel to the grounding electrode system with a # 8 AWG copper conductor.

F. Where conductors and cables are routed in boxes or enclosures, they shall be neatly bundled with cable ties at intervals not to exceed 12 inches on center. The tension for the cable ties shall be set with a tool specifically made for this purpose and of the same manufacturer as the cable tie. Side cutters or other type tools shall not be used to cut the tail end of the cable tie. The CONTRACTOR shall only use the tool specifically made for this purpose and designed for use with the cable ties provided.

3.02 SOURCE QUALITY CONTROL

A. Tests and Inspections

1. CONTRACTOR shall notify the ENGINEER 14 days prior to commencement of shop testing. All equipment shall be tested prior to site delivery.

2. CONTRACTOR-developed test forms shall accompany the notification of testing.

a. Test forms shall list all field connections at terminal strips and all internal logic circuits, along with the method planned for simulation of field conditions to test these connections and circuits.

3. All analog instrument loops shall be tested using an analog signal generator by applying the appropriate control signal to the field termination terminal strip.

a. At a minimum, analog instrument tests shall be made at 0%, 25%, 50%, 75%, and 100% of maximum control signal.

b. Additional analog instrument tests shall be made as appropriate.

4. All digital control circuits shall be tested by: applying the appropriate control voltage to the field termination terminal strip when externally supplied; using a jumper at the field termination terminal strip when internally supplied; or, if applicable, at an internal panel connection point when field terminations are not used.

B. Verification of Performance

1. Device functions shall be observed by the ENGINEER, to determine satisfactory operation of the device and connected circuit continuity, prior to shipment.

3.03 FIELD QUALITY CONTROL

A. Site Tests, Inspection

1. CONTRACTOR shall install, calibrate and test, all systems prior to notifying ENGINEER of witness testing verification.

2. The ENGINEER shall utilize the Process Control Test Certification included in Section 26 01 06 Starting and Adjusting to systematically verify the process control system is operating as designed. The CONTRACTOR shall perform the tasks necessary to confirm proper operation to the ENGINEER.

END OF SECTION

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SECTION 40 78 15

PUMP DISCONNECT PANELS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. Requirements pertaining to the construction and installation of the Pump Disconnect Panels.

1.02 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Contractors Association (NECA)
2. National Electrical Installation Standard (NEIS)
    a. 5055, Standard of Installation
3. National Fire Protection Association (NFPA)
    a. 70, National Electrical Code (NEC)
    b. 79, Electrical Standard for Industrial Machinery
4. Underwriters Laboratories, Inc. (UL)
    a. 3121-1, Standard for Safety for Process Control Equipment
    b. 508, Industrial Control Equipment
    c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations
5. National Electrical Manufacturer's Association (NEMA)
    a. 250, Enclosures for Electrical Equipment
    b. ICS 1-2000, Industrial Control and Systems General Requirements

1.03 SUBMITTALS

A. Submit all the product data in Division 40 at the same time. Piecemeal submittals will be rejected as incomplete.

B. Submittal Format:

1. The product data shall be provided as individual PDFs for each Section, unless otherwise noted for specific items. Each PDF shall be numbered to match the specification Section numbers. Submittals not itemized and labeled as specified will be rejected as incomplete.
2. A submittal is required for each product specified. Each individual product submittal shall have the corresponding Reference Keynote Number (example - 260000.A01) typewritten in the upper right hand corner of the submittal. The submittals within each Section tab shall be in the same sequential order as they

are listed in the specification Section. Submittals not containing the Reference Keynote Number will be rejected as incomplete.

3. No typical submittals will be accepted. Each submittal shall be project specific and clearly identify specifically which components or parts are being submitted for approval. Any product submittals, such as a catalog sheet, which do not clearly identify which components or parts are being submitted for approval, will be rejected as incomplete.

4. Submittals in PDF shall include an index, table of contents, or bookmarks with hyperlinks to the associated page of all submitted items. Index shall include each product specified with their corresponding Reference Keynote Number. Electronic submittals not containing a linked index, table of contents, or bookmarks will be rejected as incomplete.

C. Refer to Section 26 05 00 – Common Work Results for Electrical Submittals for additional requirements.

D. Product Data

1. Pursuant to Section 01 33 00 – Submittals.

2. Manufacturer's data including materials of construction, methods of installation and related information for each item specified in PART 2 PRODUCTS.

E. Shop Drawings

1. Dimensional drawings showing the overall length, width, and height of the assembled control panel. Included on these drawings shall be the back panel layout of installed control devices showing part numbers, dimensions, nameplate text, and other details required for a complete assembly. The CONTRACTOR shall obtain the Drawings for the control panel layout and schematic from the ENGINEER. The CONTRACTOR shall modify the Drawings as required for submittal and for as-built documentation. The CONTRACTOR shall not generate their own drawings.

2. For large control panel, physical properties, handling, mounting, shipping break point locations shall be shown in submittal drawings. This shall include total weight, lifting instructions, height, and floor space required.

3. Provide electrical schematic drawings that include: wiring details such as internal and field connection terminal block numbers; shielded wire termination requirements; grounding requirements; and wire colors. Show all required internal and external interlocking. Each drawing shall be circuit specific for the system submitted. No typical schematic drawings shall be submitted.

4. Drawings shall list the equipment number of the box, control panel, or center submitted.

5. Component designations shall match those shown on the Drawings.

6. Complete bills of materials shall be included with submittal.

1.04 QUALITY ASSURANCE

A. Qualifications

1. Equipment provided as part of this section shall be manufactured by a single licensed firm, regularly engaged in the design and manufacture of such equipment for a minimum of five years. The control panels shall have a UL508A listing. Components within control panels shall be listed in a manner consistent with UL508A requirements.

1.05 MAINTENANCE

A. Manufacturer shall provide and list in the bill of materials the following spare parts.

1. One each of all power and control fuses provided in the assembled control panel/ center.

B. Provide Operation and Maintenance Data and Manuals Pursuant to the Contract Documents.

PART 2 - PRODUCTS

2.01 COMPONENTS

A. Disconnect Panel (477815.E01)

1. Provide all electrical and control components within the Pump Control Panel as shown on the Drawings and in Section 40 78 00 Panel Mounted Equipment.

B. Meltric Cord and Plug Assembly (407815.R01).

1. Provide a cord and plug assembly for each pump cord.

2. IP67.

3. Shall be horsepower rated per UL 1682, 98 and 508A and NEC 430.

4. Shall perform as a true functioning disconnect switch for motor and inductive loads without the need for an electrical or mechanical interlock.

5. Shall make or break up to 1000 VAC and up to one and a half times the rated current of the assembly.

6. Dead front construction to prevent user access to live parts.

7. Silver-nickel (85/15) butt-style spring loaded contacts.

8. Provide pilot contacts as required for motor over-temperature sensors, moisture leak sensors, and other control features required by the Pump Supplier.

C. Disconnect Stand (407815.S01).

1. A lockable pump disconnect panel stand shall be provided as shown on the drawings. The disconnect panel stand shall be constructed of 304 stainless steel.

2. The disconnect panel stand shall be the same width and depth as the disconnect panel. The bottom of the disconnect panel shall be mounted a minimum of 48 inches above the bottom of the Influent Pump Station and surrounding grade. The disconnect panel stand shall extend from the bottom of the disconnect panel

to the finish grade adjacent to the Influent Pump Station structural slab. The entire front panel of the stand shall be a lockable, hinged door capable of opening 180 degrees, and shall not result in any gaps when the door is closed. The door shall include a padlock hasp.

3. The stand frame shall be constructed using stainless steel tube, angle, or bars. The sides of the stand and the door shall be enclosed with stainless steel expanded mesh or perforated sheets.

PART 3 - - EXECUTION

3.01 INSTALLATION

A. All identification labeling shall be in compliance with Section 26 05 53 – Identification for Electrical Systems.

B. Panels, panel-mounted equipment and listed accessories shall be pre-assembled at the control supplier's factory. No work, other than correction of minor defects or minor transit damage, shall be done to the panels at the job site without written consent by the Owner.

C. Prior to installation of panels that contain both power and control/signal wiring, verify that any installed conduits are properly located to allow wiring to be installed inside the panels to avoid interference between power and control/signal wiring.

D. Install equipment and materials in a neat and workmanlike manner and align, level and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance, and repair. Any conflicts with other existing equipment shall be brought to the attention of the Owner's before any modifications are made.

E. For all conductors terminating on terminal strips, install crimp-on, insulated plastic sleeve ferrules on each wire. Install ferrules with a crimping tool provided by the ferrule manufacturer for that purpose.

F. Individual conductors and cables shall be grouped together and routed through plastic wire ducts mounted on the backpanel surface.

G. Bond each enclosure back-panel to the grounding electrode system with a # 8 AWG copper conductor.

H. Where conductors and cables are routed in boxes or enclosures, they shall be neatly bundled with cable ties at intervals not to exceed 12 inches on center. The tension for the cable ties shall be set with a tool specifically made for this purpose and of the same manufacturer as the cable tie. Side cutters or other type tools shall not be used to cut the tail end of the cable tie. The CONTRACTOR shall only use the tool specifically made for this purpose and designed for use with the cable ties provided.

3.02 SENSOR AND INSTRUMENTATION INSTALLATION

A. Level probes, float switches and transducers shall be mounted on cable hanger at levels shown and demonstrate proper operation.

B. Provide all sensors, switches, and transducers with excess cable to allow the probes to be lowered to the bottom of the wetwell as required to test probe operation by manually lowering to the water level.

3.03 CABLE INSTALLATION

A. Excess cable shall be neatly coiled and hung in the wetwell in a manner so as not to interfere with pump removal or access to the pump removal lifting chain.

B. Excess cable coils shall be secured with plastic ties, and hung as high in the wetwell as feasible. Excess cable shall not be stored or coiled inside the disconnect panel stand.

3.04 SOURCE QUALITY CONTROL

A. Tests and Inspections

1. CONTRACTOR shall notify the ENGINEER 14 days prior to commencement of shop testing. All equipment shall be tested prior to site delivery.

2. CONTRACTOR-developed test forms shall accompany the notification of testing.

a. Test forms shall list all field connections at terminal strips and all internal logic circuits, along with the method planned for simulation of field conditions to test these connections and circuits.

3. All analog instrument loops shall be tested using an analog signal generator by applying the appropriate control signal to the field termination terminal strip.

a. At a minimum, analog instrument tests shall be made at 0%, 25%, 50%, 75%, and 100% of maximum control signal.

b. Additional analog instrument tests shall be made as appropriate.

4. All digital control circuits shall be tested by: applying the appropriate control voltage to the field termination terminal strip when externally supplied; using a jumper at the field termination terminal strip when internally supplied; or, if applicable, at an internal panel connection point when field terminations are not used.

B. Verification of Performance

1. Device functions shall be observed by the ENGINEER, to determine satisfactory operation of the device and connected circuit continuity, prior to shipment.

3.05 FIELD QUALITY CONTROL

A. Site Tests, Inspection

1. CONTRACTOR shall install, calibrate and test, all systems prior to notifying ENGINEER of witness testing verification.

2. The ENGINEER shall utilize the Process Control Test Certification included in Section 26 01 06 – Starting and Adjusting to systematically verify the process control system is operating as designed. The CONTRACTOR shall perform the tasks necessary to confirm proper operation to the ENGINEER.

END OF SECTION

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SECTION 40 80 00

COMMISSIONING OF PROCESS SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes

1. The section includes the requirements pertaining to the checkout, calibration, and testing of the instrumentation provided as part of this project.

1.02 SYSTEM START UP, COMMISSIONING, AND OWNER'S TRAINING

A. General

1. CONTRACTOR shall provide the OWNER with a written notice a minimum of four calendar days prior to system start-up. The project schedule shall not be sufficient notice.

B. Checkout

1. After installation and connection work has been completed, CONTRACTOR shall verify the equipment is properly installed.

2. CONTRACTOR to verify the following

a. Polarity of electric power and signal connections.

b. Correct applied voltages to all equipment.

c. Required grounds are properly connected.

d. The integrity of all connections.

3. CONTRACTOR shall certify in writing each loop or system has been verified for proper installation.

C. Calibration

1. CONTRACTOR shall provide labor, tools, and equipment to calibrate each instrument in accordance with the manufacturer's specifications and instructions.

2. Analog instruments shall be calibrated and tested in place without removal.

3. Test equipment and instruments used to simulate inputs and read outputs shall be suitable for the purpose intended and shall be calibrated to accuracy greater than the required accuracy of the instrument being calibrated. Test equipment shall have accuracy traceable to the National Bureau of Standards.

D. Analog Loop Tests

1. CONTRACTOR shall provide labor, tools, and equipment to field test, inspect and adjust each instrument installed under this contract to its specified performance requirement in accordance with manufacturer's specifications and instructions.

2. Instruments provided by CONTRACTOR which fails to meet any contract requirement or any published manufacturer performance specification for

functional and operational parameters not specified in the contract, shall be repaired or replaced, at no cost to OWNER.

3. Each element of the analog loop shall be tested and exercised by the CONTRACTOR to demonstrate proper operation, first individually and then as a complete loop.

4. Each analog loop shall be tested to verify proper performance within specified accuracy tolerances.

E. System Testing

1. The CONTRACTOR shall notify the ENGINEER a minimum of 14 days in advance of the scheduled system testing.

2. System testing shall not commence until after approved acceptance of all wire, calibration, and loop tests.

3. All systems shall be tested prior to the beginning of plant operational testing.

4. Completion of system testing activities shall be documented by a certified report, including all test forms, with test data entered, furnished to ENGINEER.

5. System testing shall at a minimum demonstrate the following:

   a. Each component of the system operates properly with all other components of the system.

   b. Analog control loops operate in a stable manner.

   c. Interlocks perform properly.

   d. Control sequences perform properly.

6. System testing activities shall include the use of water to establish service conditions simulating normal final control element operating conditions in terms of applied process loads, operating ranges and environmental conditions.

7. Final control elements, control panels and supplementary equipment shall be tested under start up and steady state operating conditions to verify proper and stable control is achieved using all control center and field mounted control circuits associated with each system.

8. Hardwired and software control circuit interlocks and alarms shall be operational.

9. Control of final control elements and supplementary equipment shall be tested using both manual and automatic control circuits.

10. Stable steady state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers, to eliminate oscillatory final control element operation.

11. CONTRACTOR shall submit to ENGINEER a copy of completed test reports specified in this Section and Section 26 01 08 - Electrical Testing.

F. System Start Up

1. After system Calibration and Testing verification is complete, CONTRACTOR shall inform the ENGINEER in writing that the station controls are installed according to the Drawings and that the station is ready for Start Up.

2. When Start Up begins, the CONTRACTOR shall have his technicians available on site at all times during testing to aid the ENGINEER.

3. After ENGINEER has verified all installed control systems are operating properly, commissioning may commence.

G. Commissioning

1. CONTRACTOR shall then perform Commissioning as follows:

a. Operating the station for 14 consecutive days without a significant interruption with the exception of any interruption caused by training conducted during this time period.

b. The station shall be operated in every designed control mode including the operation of all equipment.

2. Should a significant interruption occur the fault causing the interruption shall be corrected by the CONTRACTOR and the Commissioning period of 14 consecutive days shall be restarted.

H. OWNER's Training

1. Coordinate with OWNER.

PART 2 - PRODUCTS – NOT USED.

PART 3 - EXECUTION – NOT USED.

END OF SECTION

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SECTION 40 80 01

TESTING GRAVITY FLOW PIPELINES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Acceptance testing of gravity flow, sanitary sewer, storm drain pipelines, including:

1. Visual inspection of pipes.
2. Leakage testing of pipes.
3. Leakage testing of manholes.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section

1. Section 01 33 00 – Submittals

1.03 PERFORMANCE REQUIREMENTS

A. Perform leakage testing to verify compliance with the maximum allowable leakage criteria specified in this Section. Refer to tables in this Section for leakage criteria.

B. Repair or replace sections of pipelines and manholes that fail to meet the specified requirements and retest until the leakage criteria is satisfied.

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Before testing begins and in adequate time to obtain approval through the submittal process, prepare and submit a test plan for review by the Engineer. Include testing procedures, methods, equipment, and tentative schedule.

C. Submit test reports for each test on each segment of pipeline.

1.05 SEQUENCE AND SCHEDULING

A. Perform testing after placing and compacting Bedding Material around the pipe, or after backfilling the pipe trench, at Contractor's option. Schedule testing so that no more than 1,000 lineal feet of installed gravity flow piping remains untested at any one time.

B. Coordinate testing schedules with Owner. Perform testing under observation of Owner.

PART 2 - NOT USED

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure gauges and other devices necessary for proper testing and inspection of pipelines.

B. Test pressures shall account for ground water elevation.

3.02 TESTING LINE AND GRADE

A. Confirm pipe alignment visually by flashing a light between manholes. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

3.03 LEAKAGE TESTING

A. Test Options:

1. Test gravity flow, sanitary sewer sanitary sewer and storm drain pipes and manholes for leakage.

a. Gravity flow pipelines 24-inches in diameter and smaller may be tested by either hydrostatic means or by low pressure air testing.

b. Test gravity flow pipelines larger than 24-inches in diameter by hydrostatic means, low pressure air testing or joint testing.

B. Compensating for Ground Water Pressure:

1. When Contractor elects to test pipe after backfilling the pipe trench, groundwater pressure must be taken into account to eliminate influence on the leakage test.

2. Determine groundwater elevation as follows:

a. Install a 1/2-inch diameter pipe nipple, approximately 10” long, through the wall of each manhole. Cap the end of the pipe nipple that protrudes into the manhole. Locate pipe nipple at the crown of the new gravity pipeline where the pipeline enters the manhole. Install pipe nipple at the same time the gravity pipeline is constructed.

b. Before performing pipeline leakage acceptance test, remove the cap from the pipe nipple and clear the pipe nipple with air pressure. Connect a clear plastic tube to the nipple, run the tube vertically inside the manhole and allow groundwater to rise in the tube.

c. After groundwater stops rising, measure the height in feet of water over invert of the pipe.

3.04 HYDROSTATIC LEAKAGE TESTS

A. Determine groundwater elevation.

B. Plug wyes, tees, stubouts, laterals and other connections to the sewer. Plug sewer pipeline in the downstream manhole. If necessary to isolate flow, plug incoming pipes in the upstream manhole.

C. When test pressures require installation of a riser pipe, connect riser pipe to pipe in the upstream manhole.

D. Fill sewer pipe and manholes with water to the specified test elevation, compensating for the measured groundwater elevation.

3.05 LOW PRESSURE AIR TESTING

A. Conduct air pressure testing in accordance with ASTM C924.

B. When low pressure air testing is used to test concrete pipes, a wetted pipe interior is recommended.

C. Pressurize the pipe section to be tested to 4.0 pounds per square inch and hold this pressure for 5 minutes. After this time period, allow pressure to drop.

D. When internal air pressure reaches 3.5 pounds per square inch, begin measuring rate of air pressure loss. Record the time interval required for the internal air pressure to drop from 3.5 psi to 2.5 psi.

E. Acceptance Criteria: The pipeline under test is acceptable when the time interval so recorded exceeds the minimum test time given by the following table:

MINIMUM Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig:	
Nominal Pipe Diameter, Inches	Minimum Time Allowed per 100 Lineal Feet of Pipe Under Test, Minutes
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.8

F. Any section of pipe which fails to meet requirements shall be repaired and retested.

3.06 LEAKAGE TESTING FOR MANHOLES

A. After completion of manhole construction, wall sealing, or rehabilitation, test manholes for water tightness using hydrostatic or vacuum testing procedures.

1. New Manhole Construction: Conduct test prior to backfilling.

B. Plug influent and effluent lines connected to manhole with suitably-sized pneumatic or mechanical plugs.

1. Utilize plugs that are properly rated for pressures required for test.

2. Place plugs a minimum of 6 inches outside of manhole walls.

3. When pipes connected to the manhole have not been backfilled, brace pipes to prevent dislodging from the manhole.

C. Vacuum Testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure; do not over-inflate.

2. Evacuate manhole with vacuum pump to 10” mercury (Hg), disconnect pump, and monitor vacuum for the time period specified in the following table.

Depth in Feet	Time in Seconds by Manhole Diameter		
	48”	60”	72”
4	10	13	16
8	20	36	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
[a]	5	6.5	8.0

[a] Add times for each additional 2-feet of manhole depth. (The values listed above have been extrapolated from ASTM C924-85).

3. If the drop in vacuum exceeds 1” Hg over the specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

D. Hydrostatic testing:

1. Fill manhole with water to top of frame. Add water over a 24-hour period to compensate for absorption and evaporation losses. After 24 hours, refill to top of frame and observe for loss of water. If, after a 4-hour period the water level is reduced by more than 1/4”, the leakage shall be considered excessive. Contractor shall make necessary repairs and retest the manhole.

2. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test produce until satisfactory results are obtained.

END OF SECTION

SECTION 40 80 02

TESTING PRESSURE PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Hydrostatic pressure pipeline testing.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittals
2. Section 01 52 00 – Construction Facilities and Utilities
3. Section 01 99 00 – Reference Forms
4. Section 40 05 10 – Piping Systems

1.03 SUBMITTALS

A. Provide Submittal per Section 01 33 00.

B. Testing Schedule and Notification of Testing: Submit advance written notice of testing activities a minimum of 48 hours prior to conducting piping tests.

C. Testing Plan: Submit a written plan that identifies the methods for water procurement, conveyance and disposal.

D. Completed Pipe Test Record Forms, found in Section 01 99 00.

1.04 TESTING REQUIREMENTS

A. Furnish personnel, materials, bulkheads, test plugs, restraints, anchors, temporary connections, pumps, pressure gauges and other equipment needed to perform testing.

B. Water for Testing

1. Use potable water for pressure testing pipelines. Obtain water from the source identified in Section 01 52 00.
2. Disposal:
    a. Obtain approvals from the Oregon Department of Environmental Quality and other regulatory agencies to dispose of water in existing drainage ditches and other surface water features. Pay all costs to convey or transport water to the point of disposal.
    b. Dispose of water used for testing pipelines in the sewer collection system or per Paragraph 1.04.B.2.a above.

C. Test only those portions of the pipe that have been installed as part of this Contract.

1. Test new pipe sections prior to making final connection to existing piping.
2. Install test plugs or bulkheads to isolate new piping systems.

3. Unless otherwise indicated, valves may not be used to isolate portions of the piping system for purposes of testing. When testing against a valve is indicated or approved by the Owner, provide a test plate "pancake" to further isolate the new and existing piping.

D. Sequence

1. Buried Pressure Piping: Except as otherwise indicated, conduct piping pressure test after trench has been backfilled to subgrade and compacted. Piping may be tested before or after final paving, at Contractor's option.

2. Encased Piping: Test before encasing pipe in concrete.

E. Failed Tests: Make necessary corrections or remove defective pipe or defective appurtenances. Repeat pressure test until a successful test is achieved.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. Test pipelines, appurtenances, valves, and fittings in the pipeline system.

B. Where allowable leakage rates are not specifically indicated, no leakage is allowed.

C. Perform testing operations in the presence of the Engineer.

D. Prior to pressure testing, clean pipeline of debris, construction materials, dirt and other foreign material within the piping system.

E. Do not test pipelines until thrust restraint devices have been installed. Where concrete thrust blocks are used, do not begin pressure test until concrete has attained an age of at least 7 days unless otherwise approved by the Owner. Pressure test buried pipe after backfill.

F. After testing has been completed, drain test water from pipelines and leave in clean condition.

3.02 FILLING PIPING SYSTEMS WITH WATER

A. Place temporary bulkheads in the pipe at the ends of the test section, and then slowly fill the pipeline with water at a rate which does not cause surges or exceed the rate at which the air can be released through the air valves.

B. Ascertain that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe.

C. Purge air within the pipeline during the filling operation. Check proper operation of air release valves and air vents during the filling operation to ascertain proper operation and venting of air from the pipeline.

D. Concrete pipe, cement-mortar lined pipe and other pipe made from water absorbing material:

1. After the filling operation is complete, allow the filled pipeline to stand under a slight pressure for at least 24 hours to allow air to escape from any air pockets within the pipeline and the pipe lining to absorb water.

2. Examine bulkheads, valves and connections for leaks during this period. If leaks are found, make corrections before conducting the pressure test.

3.03 PRESSURE TESTING EXPOSED PIPING

A. Test exposed piping as follows:

1. Fill section of piping under test with water and raise the system pressure to a test pressure of 150 psi.

2. Visually inspect exposed pipe joints, joints at fittings, valves, hydrants, and other piping appurtenances for leaks.

3. Correct leakage as necessary to eliminate the leakage.

4. Duration of Pressure Test: 2 hours.

5. Leakage Allowances: Zero leakage.

6. Correct any visible leakage by tightening flanges and screwed joints, replacing gaskets or removing defective materials.

7. Repeat test until no leakage is observed.

8. Record results of pressure test on Pipe Test Record form, included in Section 01 99 00.

3.04 PRESSURE TESTING BURIED PIPING NON-HDPE

A. For pressure testing of HDPE pipe, See Paragraph 3.05. For other buried pipe materials, pressure test as follows:

1. Fill section of piping under test with water and raise the system pressure to a test pressure of 150 psi. The test pressure shall not be allowed to drop below 150 psi for the duration of the test. If the test pressure drops below 150 psi at any time, the test will be void.

2. The test pressure shall be calculated for the point of highest elevation of the water line but shall not exceed 200 psi at any point

3. Visually inspect exposed pipe joints, joints at fittings, valves, hydrants, and other piping appurtenances for leaks. The use of bell repair clamps or other similar devices to stop leaks due to defective materials or poor workmanship will not be permitted.

4. Correct visible leaks necessary to eliminate the leakage.

5. Duration of Pressure Test: 2 hours.

6. Leakage Measurement:

a. Begin test once visible leaks have been eliminated.

b. Maintain test pressure during the test period by adding makeup water to a calibrated test reservoir.

c. Accurately measure the volume of makeup water introduced into the pipeline to maintain the test pressure to determine the leakage rate for the test.

7. The pipeline pressure test is successful when the makeup water added during the test is equal to or less than the allowable leakage rate (L) defined below.

8. Gasketed Ductile Iron Pipe (mechanical or push-on joint)

$$L = \frac{SD(P)^{1/2}}{148{,}000}$$

L = Allowable leakage in gallons per hour.

S = Length of the test section in feet.

D = Nominal diameter of the piping in inches.

P = Test pressure in pounds per square inch gauge.

9. Steel Pipe (AWWA C200, Concrete Bar Wrapped Cylinder Pipe (AWWA C303)

a. Gasketed joints:

1) L= 6.25 gallons/inch diameter/mile/24 hours

2) L= allowable makeup water in gallons.

b. Welded joints: No leakage allowed.

c. Where pipeline consists of a combination of welded and gasketed joints, adjust the formula above by the ratio of the joint types over the test section.

10. Polyvinyl Chloride (PCV) pipe:

$$L = \frac{ND(P)^{1/2}}{7{,}400}$$

L = Allowable leakage in gallons per hour.

N = Number of joints in the length of pipeline to be tested.

D = Nominal diameter of the piping in inches.

P = Test pressure in pounds per square inch gauge.

11. Record results of pressure test on Pipe Test Record form, included in Section 01999.

3.05 PRESSURE TESTING HDPE PIPING

A. Pressure test as follows:

1. Tests should be conducted in accordance with Chapter 9 of AWWA M55 and the following:

a. HDPE and DI pipes shall be pressure tested separately before tie-in connections. All tie-in joints between HDPE and DI pipe shall be visually

inspected at working pressure. Leaks at joints shall be repaired and re-inspected. Test all HDPE water mains and appurtenances including HDPE to DI transition fittings under a hydrostatic pressure equal to 150 psi.

b. The Contractor shall schedule pressure testing such that pressure changes due to thermal expansion or contraction of the pipe during the test period is minimized.

c. Fill section of piping under test completely. The test section is usually filled from the lowest point of the pipeline and at a slow fill rate to minimize air entrainment. After filling, allow time for the system to reach thermal equilibrium and allow for any dissolved air to exit the system air vents.

d. Gradually pressurize the test section to 150 psi and add make-up water as necessary to maintain pressure in the pipeline within 5 psi of the test pressure for a period of four (4) hours. During this initial expansion phase, polyethylene pipe will expand slightly due to elasticity and Poisson effects. Additional test liquid will be required to maintain pressure. The amount of additional test liquid will vary because expansion in the PE pipe is not linear.

e. If test pressure cannot be attained, or if it takes an unreasonably long time to reach test pressure, there may be faults such as excessive leakage, entrapped air, or open valving, or the pressurizing equipment may be inadequate for the size of the test section. If such faults exist, discontinue pressurizing and correct them before continuing.

f. Immediately following the initial expansion phase, reduce test pressure by 10 psi and stop adding test liquid. Monitor the pressure for 1 hour.

g. If no visual leakage is observed and test pressure remains steady (within 5% of the target value) for one (1) hour, no leakage is indicated.

h. Under no circumstances should the total time for initial pressurization and time at test pressure exceed eight hours at 1.5 times the system pressure rating. If the test is not complete because of leakage, equipment failure, or any other reason within this total time, the test section should be depressurized and allowed to “relax” for at least eight hours before starting the next testing sequence.

i. Record results of pressure test on Pipe Test Record form, included in Section 01999.

END OF SECTION

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SECTION 43 25 02

SUBMERSIBLE WASTEWATER PUMP SOLIDS HANDLING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Submersible pumps complete with motor, discharge fitting, guide bar brackets, access frames and covers and accessories suitable for pumping unscreened wastewater at variable speed.

B. Provide heavy-duty, submersible dry-pit centrifugal non-clog type, suitable for pumping fluids containing unscreened wastewater solids.

C. Equipment List

1. Influent Pump Station Pump No. 1: PMP-110-01
2. Influent Pump Station Pump No. 2: PMP-110-02
3. Influent Pump Station Pump No. 3: PMP-110-03
4. Influent Pump Station Pump No. 4: PMP-110-04
5. Influent Pump Station Pump No. 5: PMP-110-05

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01 33 00 – Submittals
2. Section 01 45 23 – Testing and Inspection
3. Section 01 61 10 – Seismic Design Requirements
4. Section 01 61 11 – Seismic Anchorage and Bracing
5. Section 01 66 00 – Materials and Equipment
6. Section 01 78 23 – Operation and Maintenance Information
7. Section 01 79 00 – Training
8. Section 01 81 00 – Equipment and System Testing
9. Section 01 82 50 – Facility Start-Up and Commissioning
10. Section 01 99 00 – Reference Forms
11. Section 05 50 01 – Anchor Bolts and Anchoring Devices
12. Section 40 61 96.13 – Process Control Descriptions – Influent Pump Station Pumps

1.03 REFERENCED STANDARDS

A. The following Standards and referenced in this Section. Refer to the latest version of each document:

1. American National Standards Institute

a. ANSI/Hydraulic Institute

2. American Society for Testing and Materials International

a. ASTM A48 – Standard Specification for Gray Iron Castings

b. ASTM A276 – Standard Specifications for Stainless Steel Bars and Shapes

c. ASTM A479 – Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

d. ASTM A532 – Standard Specification for Abrasion-Resistant Cast Irons

3. International Organization of Standardization

a. ISO 1940 – Mechanical Vibration – Balance Quality Requirements of Rigid Rotors

b. ISO 9001 – Quality Management Systems

4. National Electric Manufacturers Association

a. NEMA MG-1 – Motors and Generators

5. National Fire Protection Association

a. NFPA 70 – National Electric Code

6. UL Standards

a. UL 674 – Electric Motors and Generators for Use in Hazardous (Classified) Locations

1.04 DESIGN REQUIREMENTS

A. Design Criteria

1. Designed for use with self-cleaning trench style wet well.

2. Design for continuous operation under submerged, partially submerged or totally dry condition without damage to the pump and motor. Special attention shall be devoted to the shaft design to limit the deflection and to integration of the design of rotating components for operation with the boundaries established by the operating conditions specified in this section.

3. Design specifically designed to pump unscreened raw water or wastewater and operate without clogging or fouling caused by material in the pumped fluid at any operating condition within the range of service specified.

4. Design to operate without cavitation over the full range of operating conditions.

5. Design for continuous submergence without loss of watertight integrity to a depth of 65 feet.

6. Design so motor and rotating parts are removable from the motor end of pumps.

7. Provide head/capacity curves which slope continuously with no flat spots or reverse slope.

8. Design to operate without overload on any component at any point along the pump's entire operating curve.

9. Provide capability to operate at shutoff head for durations up to 30 seconds without overloading or damage.

10. Comply with the following:

Parameter	IPS Pumps 1 & 2	IPS Pumps 3-5
Rigid Sphere, inches diameter (minimum), capable of passing through the pump from inlet to discharge[a]	3	
Maximum Hydraulic Efficiency, minimum, percent[b]	70	75
Minimum Nominal Inlet Diameter, inches	6	12
Minimum Nominal Discharge Diameter, inches	6	12
VFD	Yes	Yes
Maximum Nominal Motor Speed, rpm	1800	1200
Motor:		
Horsepower, Maximum	30	75
Voltage/Cycle/Phase	480/60/3	480/60/3
Service Factor	1.15	1.15
Insulation Rating	H	H
Enclosure	FM Explosion Proof	FM Explosion Proof
a. For pumps 10 inches in discharge nozzle diameter and less, this dimension shall be the minimum clearance between the outside diameter of the impeller and the volute cutwater. The sphere shall be a solid sphere, incapable of compression or distortion of any kind. b. Efficiency is the minimum acceptable value at the maximum efficiency point on the pump's efficiency/capacity curve for the selected impeller and is not necessarily to be associated with any specified operating condition.		

B. Performance Criteria

1. Pumps will operate as individual units. See control description Section 40 61 96.13.

2. The fluid to be pumped is anticipated to range between 35ºF and 85ºF. The fluid is unscreened wastewater containing up to 500 mg/L of solids consisting of grit, organic material, small quantities of petroleum products, plastic, and animal fats and greases.

3. Pumps will be operated by a control system in accordance with Section 40 61 96.13.

4. Pumps shall be suitable for long -term operation under a constant or variable speed operation as conditions require under the following conditions:

   a. Ambient Environment: Municipal Wastewater Wet Well Interior

   b. Ambient Temperature: 20-104°F

   c. Altitude: 520 feet

5. Factory Test: Test each pump for performance at the factory to determine head versus capacity at seven different points, efficiencies, and kilowatt draw required for the operating points that are specified. All tests shall be run in accordance with ANSI/HI 11.6. Any deviations shall be subject to review by the Owner. A written report stating the tests have successfully been completed along with the results of the shall be provided as product data. In addition, the following procedures shall be followed:

   a. Impeller, motor rating and electrical connections shall first be checked for compliance with the specifications.

   b. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.

   c. The pump shall be run for 30 minutes submerged, with a minimum of 6 feet of water over the top of the motor. Following this warm-up period, the pump shall be subjected to the performance and NPSHR tests according to ANSI/HI 11.6.

   d. After satisfactory completion of the performance and NPSHR tests, the motor shall be subjected to a housing leakage test performed under vacuum in accordance with paragraph 11.6.7.2.2 of ANSI/HI 11.6.

   e. All motor circuits, including thermal and moisture sensors and the moisture sensors in the shaft seal area, shall be subjected to electrical resistance tests to determine functionality. In addition, the motor shall be subjected to a dielectric high potential test in accordance with paragraph 11.6.7.2.5 of ANSI/HI 11.6.

C. Operating Conditions:

1. The operating conditions presented in tabular form below are intended to describe the results of hydraulic calculations developed specifically for the purpose. The calculations were intentionally used to develop the limits of the expected extremes in variation of static head, coefficients for pipeline resistance, and turbulence losses through fittings and valves. Equipment furnished under this section shall be fully suitable for continuous operation at any specified condition or any condition lying between the extremes of the operating conditions specified in the following table. The notes presented at the end of this table are intended to be complimentary to the information presented in the table.

Equipment Numbers	IPS Pumps 1 & 2	IPS Pumps 3-5
Maximum Speed Operation	60 Hz	60 Hz
Condition A[a, d, e] - Dual Pump Operation, Max Speed per Pump		
Capacity, gpm	1000	4300
Total head, feet	50	47
NPSHA, feet	29.5	25.25
Condition B[b, d, e] - Single Pump Operation, Max Speed		
Capacity, gpm	1250	4700
Total head, feet	42.5	40
NPSHA, feet	29.5	25.25
Condition C[c, d, e] - Single Pump Operation, Reduced Speed		
Capacity, gpm	350	2000
Total head, feet	28.5	29
NPSHA, feet	29.5	25.25

a) Condition A shall be taken as the rated operating condition. Performance at the rated condition shall be guaranteed in accordance with tolerances set forth in the Test Standards of the Hydraulic Institute specified herein. Condition A has been selected to obtain the rated pumping capacity for the installation. It is not intended that the pumps be selected for maximum efficiency at Condition A. Pumps furnished under this section should be selected to achieve Condition A performance, but also operate continuously without objectionable vibration or cavitation at the head specified under Condition B. Condition A may be located in the Allowable Operating Region as established by the pump manufacturer in accordance with ANSI HI 9.6.3 and published in the manufacturer's published application data for the specific model proposed in this application. Any increase in head or capacity or both which results in a power requirement greater than the pump motor's nameplate rating will be cause for rejection.

b) Condition B head is presented to indicate operating conditions when the pump is operating at maximum speed. Condition B shall be used for pump selection. Condition B shall be located within the Preferred Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and listed in the manufacturer's published application data for the specific model proposed for this application. Pumps with head-capacity curves steeper than that assumed will produce somewhat less flow at somewhat lower head. The reverse will occur with pumps having a shallower head-capacity curve. Proposed pump selections meeting this discharge head requirement by operating the equipment at less than full speed will be rejected.

c) Condition C is the anticipated continuous duty reduced speed condition. Pumps furnished under this specification shall be capable of sustained (24 hours per day) operation at this condition within the Acceptable Operating Region as established by the pump manufacturer in accordance with ANSI/HI 9.6.3 and published in the manufacturer's published application data for the specific model proposed for this application.

d) Total head in the above tabulation is the algebraic difference between the discharge head and suction head as defined in ANSI/HI 1.1 through 1.6. Net positive suction head available (NPSHA) in the above tabulation is calculated in accordance with ANSI/HI 1.3 for average barometric pressure and maximum temperature conditions. For Pumps 1 & 2, an allowance of two feet has been included for a safety factor and the elevation of the centerline of the impeller is assumed to be 494.23 feet. For Pumps 3-5, and allowance of five feet has been included for a safety factor and the elevation of the centerline of the impeller is assumed to be 495.46ft. For all pumps, another 2 feet was included for the presence of volatile constituents in the pumped fluid. NPSHA at the pump impeller eye can be determined by adjusting the given value by proposed pump dimensions and the indicated requirements for pump installation details. It is the CONTRACTOR's responsibility to make this adjustment and produce calculations justifying the proposed selection. The required NPSHr of the pump shall be less than the NSPHA.

e) Operating Points may be slightly different than listed depending on pump manufacturer.

1.05 SUBMITTALS

A. Comply with Section 01 33 00.

B. Include a copy of the contract document control diagrams and process and instrumentation diagrams, with addenda updates, that apply to the equipment in this section.

1. Mark to show specific changes necessary for the equipment proposed in the submittal.

2. If no changes are required, mark the drawing or drawings “No Changes Required”.

3. Failure to comply with this paragraph is sufficient cause to reject the entire submittal.

C. Include the following:

1. Manufacturer's data including materials of construction and equipment weights.

2. Performance curves developed for the specified operating conditions showing relationship between flow, head, efficiency, speed, and horsepower.

3. Construction details and materials of construction.

4. Fully dimensioned shop drawings.

5. Motor submittal information specified herein, including a completed Motor Data Form (Section 01 99 00).

6. Equipment mounting submittal information

7. Documentation of ISO 9001 compliance.

8. Shaft deflection calculations

9. Documentation and Calculations supporting the design of the motor cooling system.

D. Deferred Submittals:

1. Equipment anchorage design and calculations shall be prepared and signed by a civil or structural engineer currently registered in the state of Oregon as specified in Section 01 61 10 & 01 61 11. The analysis for the anchorage system shall include the affect of differential loads imposed by water in the wet well moving in response to the design seismic event.

2. Submit operating and maintenance (O&M) information as specified in Section 01 78 23 a minimum of 10 days before equipment shipment.

3. Submit factory test reports as specified in Paragraph 2.05 and receive approval prior to equipment shipment. Include factory test results in final O&M manual.

4. Submit forms required following startup and training. Include forms in final O&M manual. Refer to Part 3 below.

E. Vibration

1. The pump, when operating within the manufacturer’s listed Preferred Operating Region (POR) with wet well levels as indicated for normal (not cleaning)

operation, shall comply with the requirements of ISO 1940 Grade G2.5. Vibration at any specified operating condition that is located outside of the manufacturer's listed POR shall not exceed 125 percent of the limiting values in ISO 1940, Grade 2.5.

F. Complete and submit the following forms from Section 01 99 00:

1. Motor Data Form.

2. Unit Responsibility Form.

1.06 QUALITY ASSURANCE

A. Unit Responsibility: Assign unit responsibility to the pump manufacturer for the equipment specified in this section. Submit a Unit Responsibility Certificate (Section 01 99 00).

B. ISO 9001 Quality System

1. Compliance by pump manufacturer is required.

2. Submit documentation of compliance prepared by independent certification agency approved by International Organization for Standardization.

3. Do not ship equipment before compliance documentation review has been completed by Owner.

C. Provide pumps from a single manufacturer.

1.07 PRODUCT DELIVERY, STORAGE, & HANDLING

A. Comply with Section 01 66 00.

1.08 WARRANTY

A. Require the pump manufacturer to warrant the units against defects in materials and workmanship. Provide as a minimum, 100% full payment coverage for parts and labor for thirty six (36) months from date of acceptance by the Owner. Provide 75% payment coverage for parts and labor for thirty seven (37) to forty eight (48) months from date of acceptance by Owner. Provide 50% payment coverage for parts and labor for forty nine (49) to sixty (60) months from date of acceptance by Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Flygt

B. ABS

C. Or equal.

D. Modify equipment as required to meet the requirements of this section.

2.02 MATERIALS

A. Materials are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. Alternative materials, however, must provide at least the same qualities as those specified for the purpose.

B. Pump Casing: Cast iron, ASTM A48, Class 35B with wetted surfaces coated with Belzona 1321 or equal.

C. Motor Casing: Cast iron, ASTM A48, Class 35B.

D. Discharge Connection Elbow/Fitting: Cast iron, ASTM A48, Class 35B.

E. Impeller:

1. Abrasion-resistant 25% chrome Cast iron, ASTM A532, Alloy IIIA OR

2. Cast iron, ASTM A48, Class 35B with wetted surfaces coated with Belzona 1321or equal.

F. Motor and Pump Shaft: Stainless steel, ASTM A479, Type 431.

G. Wearing Ring/Plate:

1. Abrasion-resistant 25% chrome cast iron, ASTM A532, Alloy IIIA OR

2. Cast iron, ASTM A48, Class 35B with wetted surfaces coated with Belzona 1321or equal.

H. Externals Bolts and Nuts: Stainless steel, ASTM A276, Type 316.

I. Guide Bar Brackets: Stainless steel, ASTM A276, Type 316.

J. Anchor Bolts: Stainless steel, ASTM A276, Type 316.

K. Guide Rails, Lifting Chain and Hook Assemblies: Stainless steel, ASTM A276, Type 316.

2.03 PUMP COMPONENTS

A. General Requirements

1. The pumps shall conform in all respects to the requirements in UL 674.

2. Design so motor and rotating parts are removable from the motor end of pumps.

3. Machine all mating surfaces where watertight sealing is required and fit with nitrile O-rings.

4. Equip pumps with statically balanced non-clog impellers designed to pass coarse solids and stringy materials.

5. Design pumps to automatically connect to the discharge piping when lowered into place on the discharge connections.

a. Make pumps easily removable for inspection or service, requiring no bolts, nuts, or other fastening to be removed for this purpose, and no need for personnel to enter pump well.

b. Seal pump to the discharge connections by a simple linear downward motion of the pump, with the entire weight of the pumping unit guided to and pressing tightly against the discharge connections.

c. Do not permit any portion of the pump to bear directly on the floor of the sump.

d. Do not require rotary motion of the pump for sealing.

e. Provide nonadjustable guide bars, to steer the pump into proper contact with the discharge connection fitting. Do not require guide bars to bear the weight of the pump.

B. Volute/Suction Cover

1. The pump volute shall be a single piece non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller.

2. The volute casing shall have a tangential or center discharge nozzle

3. The volute shall be designed for efficient conversion of kinetic to potential energy.

4. The cutwater shall be specifically designed for use in fluids with stringy solids and rags.

5. Specifically designed to bear the load associated with removal and placement of the pump and to withstand the loads imposed by the operations specified.

6. The nozzle flange face shall be designed to mate with the discharge fitting.

7. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s).

8. A wearing ring shall provide effective sealing between the impeller and the volute housing.

C. Shaft

1. The pump shaft shall be turned, ground and polished, of proportions suitable for use in the specified application.

2. The shaft shall be of sufficient section to limit deflection at the shaft seal to not more than 1.5 mils when the pump is operating at any continuous-duty point defined by the envelope of conditions specified herein.

D. Bearings

1. Support pump shafts on two bearings.

a. Upper bearing: Single row ball bearing.

b. Lower bearing: Two-row angular contact ball bearing.

2. Heavy-duty, oil lubricated or permanently grease lubricated anti-friction type double shielded and factory sealed.

3. Designed for an L-10 rating life of at least 50,000 hours for Pumps 1-2.

4. Designed for an L-10 rating life of at least 100,000 hours for Pumps 3-5

E. Impeller

1. Provide non-clogging design capable of handling solids, fibrous materials, heavy sludge, and other matter found in normal sewage applications.

2. The impeller shall be dynamically balanced, semi-open, multi-vane, back-swept, non-clog design.

3. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on the volute suction which shall keep them clear of debris, maintaining an unobstructed leading edge.

4. The impeller(s) vanes shall shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater.

5. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater.

6. Fit between the impeller and shaft shall be a sliding fit with a taper-lock bushing pressed by a screw which is threaded into the end of the shaft, or a slip fit onto the shaft and drive key and fastened to the shaft by an impeller nut having cover for protection from pumped fluid.

7. Impellers shall be locked to the shaft, held by an impeller bolt.

8. Provide a wearing ring system, designed for abrasion resistance, to provide efficient sealing between the volute and impeller.

F. Mechanical Seals

1. Provide with tandem double mechanical seals running in an oil reservoir, composed of two separate lapped face seals.

   a. For the lower seal unit, between the pump and oil chamber, provide one stationary and one positively driven, rotating tungsten-carbide or silicon-carbide ring, with each pair of rings held in contact by a separate spring.

   b. For the upper seal unit, between the oil sump and the motor housing, provide one stationary tungsten-carbide or silicon-carbide ring and one positively driven tungsten-carbide, silicon-carbide, or rotating carbon ring.

   c. Ceramic and carbon seals are not acceptable.

   d. Provide seals that require neither maintenance nor adjustment and are easily replaceable.

   e. Conventional double mechanical seals with a single or a double spring between the rotating faces, or that require constant differential pressure to affect sealing and are subject to opening and penetration by pumping forces, are not acceptable. Make submersible pumps capable of continuous submergence without loss of watertight integrity to a depth of 65 feet.

2. For each pump, provide an oil chamber for the shaft sealing system.

   a. Design oil chamber to assure that air is left in the oil chamber, to absorb the expansion of the oil due to temperature variations.

b. Provide drain and inspection plug with positive anti-leak seal which is easily accessible from the outside.

G. Cable Entry Seal

1. Design to preclude specific torque requirements to insure a watertight and submersible seal.

2. Provide a single cylindrical elastomer grommet having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the entry body containing a strain relief function, separate from the function of sealing the cable.

3. Separate the cable entry junction chamber and motor by a stator lead sealing gland or terminal board, which isolates the motor interior from foreign material gaining access through the pump top.

4. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

H. Motor and Cable

1. Squirrel-cage induction, shell type design, housed in an air-filled, watertight chamber, NEMA B type.

2. Rating: Explosion-proof, as defined by Factory Mutual (FM).

3. Insulate stator winding and stator leads with moisture resistant Class H insulation, rated for a temperature of 180ºC.

   a. The stator shall be insulated by the trickle impregnation method resulting in a winding fill factor of 95%.

4. Designed for continuous duty, capable of sustaining a minimum of 15 starts per hour.

5. Limit temperature rise of the motor to that specified in NEMA MG-1 for Class B insulating materials when operating continuously under load.

6. Hermetically seal the junction chamber, containing the terminal board, from the motor.

7. Make connection between the cable conductors and stator leads with threaded compressed type binding post permanently affixed to a terminal board.

8. Cable

   a. Continuous, nonwicking submersible electrical cable with the correct number of conductors sized in accordance with NFPA 70.

   b. Cables containing wicking fillers are not acceptable.

   c. Provide sufficient length to reach the junction box.

9. Leakage Sensor

   a. Provide to detect water in the stator chamber.

   b. When leakage sensor is activated, stop the motor and send an alarm.

   c. Operate on 120VAC.

d. Use of sensing probes between the mechanical seals are acceptable.

e. Trip temperature above 125°C (257° F) for Pumps 3-5 and 140°C (284° F) for Pumps 1-2 are not allowed.

I. Cooling System

1. Provide each unit having a motor of 15 hp or greater with a cooling system and thermal sensors to monitor stator temperatures.

a. The cooling system shall provide for continuous operation in liquid or ambient temperatures up to 104 degrees F (40 deg C).

b. The cooling system shall be specifically designed for use with variable speed applications and compatible with the application specified herein.

c. Fans, blowers, or auxiliary cooling systems mounted external to the pump motor are not acceptable.

d. The cooling system may rely on radiation of excess heat energy to the fluid in the wet well or , alternatively, the pumped fluid via a closed-circuit circulating system utilizing either oil or glycol, or a combination of these.

e. It is specifically required that the cooling system be compatible with contemplated control schedule, which may require that motor cases be exposed continuously or intermittently.

f. Cooling systems shall not employ the pumped fluid to directly cool the motor through wastewater passageways incorporated into the motor shell. It is preferred that the motor be cooled by the wastewater via fins incorporated into the motor shell.

g. If an internal liquid circulation system is employed for cooling purposes, the liquid shall be glycol or a heat transfer oil which shall in turn circulate past heat exchange surfaces incorporated into the cavity behind the pump impeller.

h. If the motor is an oil-filled type it shall be positively cooled by circulating oil through the windings to passages within the pump designed as a heat exchanger to transfer heat to the pumped fluid. Vanes cast into the rear impeller shroud shall be provided to circulate pumped flow past a heat exchanger in the shaft seal area to provide the required cooling. Cooling water passages in the motor's shell are specifically prohibited.

2. Equip stator with three thermal switches, embedded in the end coils of the stator winding (one switch in each stator phase).

a. Use thermal switches in conjunction with external motor overload protection and wire to the control panel.

b. Thermal sensors shall signal an alarm and shut down the motor when opened.

J. Control and Status Monitoring unit

1. The thermal switches and float switches shall be connected to a Flygt Mini-CAS, ABS CA 462, or equal, control and status monitoring unit for Pumps 1-2.

2. The thermal switches and float switches shall be connected to a Flygt MAS 801, ABS CA 462, or equal, control and status monitoring unit for Pumps 3-5.

3. The monitoring unit shall be designed to be mounted in the pump control panel.

2.04 ACCESSORIES

A. Provide submersible pumps with pump lifting chains, upper guide rail brackets, intermediate guide rail brackets, cable holder assemblies, safety chain hook assemblies, discharge connection fitting, anchor bolts, and all other accessories necessary to complete the installation as specified and as shown on the drawings.

B. Anchor Bolts

1. Comply with Section 05 50 01.

2. Calculations are required.

3. Minimum diameter: 3/4-inch.

C. Discharge Connection Fitting

1. Shall either be horizontal or elbow discharge type as indicated. The anchorage system shall be designed to transmit forces safely to the structure.

2. Anchor discharge connection fittings into 1.5” thick mounting plate to protect concrete at edges from cracking/breaking. Mounting plate shall be 316 stainless steel.

D. Chain

1. Equip pumps with Type 316 stainless steel chain of adequate strength and length to permit raising pumps for inspection and removal.

E. Guide System

1. Guide rails, guide supports, and anchor bolts may be provided by either the Contractor or manufacturer but, in either case, comply with the manufacturer’s requirements and the requirements of this specification for these components.

2. Provide guide rails, guide supports, and anchor bolts of Type 316 stainless steel.

3. Provide each pump with a guide rail and support system to allow easy removal of the pump without entering the wet well. The pump shall be easily removable requiring no bolts, nuts, or other fastening to be removed.

4. The pump, guiderail, and support system shall be designed to automatically connect the pump to the discharge piping when lowered into place on the discharge connection. When in place, the connection shall effect a watertight seal with the discharge fitting.

5. Guide shall be dual rail size recommended by the pump manufacturer. Systems that employ cables or single guide rails are not allowed.

6. Bolt the discharge connection to the floor and use as a lower attachment for the guide rails.

7. The design shall be non-sparking and shall conform to UL requirements for installation in a location classified in accordance with NFPA 70, article 500 for Class 1, Group D, Division 1 locations.

8. No portion of the pump shall bear directly on the floor of the sump and no rotary motion of the pump shall be required for sealing.

9. Once the pump has been positioned on it's support fitting at the discharge fitting, the guide bar system shall not be required for pump support.

F. Spare Parts

1. Provide the following spare parts for each pump model specified:

a. 2 complete mechanical seals

b. Any special tools required for seal and for bearing installation/removal or to dismantle pumps

c. Any additional spare parts recommended by manufacturer

2.05 SOURCE QUALITY CONTROL

A. Factory Testing

1. Test each pump for performance at the factory to determine head versus capacity at seven different points, efficiencies, and kilowatt draw required for the operating points that are specified. All tests shall be run in accordance with the American Hydraulic Institute Level 1B Standards for Pumps 3-5 and Level 2B for Pumps 1-2.

2. Include the following:

a. Check impeller, motor rating and electrical connections compliance with the specifications.

b. Prior to submergence, run each pump to establish correct rotation and mechanical integrity.

c. Run each pump for 30 minutes submerged, a minimum of 6 feet under water.

3. Provide written report summarizing results of the tests and stating the tests have successfully been completed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Align, connect, and install each pump in accordance with the manufacturer's written instructions.

B. Provide factory-trained personnel to check installation and test initial operation.

C. Certify installation and initial operation of all components on Manufacturer's Installation Certification Form in Section 01 99 00.

3.02 FIELD QUALITY CONTROL

A. Field quality control and inspections will be performed as specified in Section 01 45 23.

B. Corrective Actions: Replace or repair work to eliminate defects, deficiencies, and irregularities.

3.03 MANUFACTURER'S FIELD SERVICES

A. Provide field inspection and instruction services by factory-trained service technician of the manufacturer as specified in Sections 01 79 00, 01 81 00, and 01 82 50. Services by a sales representative are not acceptable.

1. Provide minimum 2 visits of 8 hours, excluding travel time, to inspect and test initial operation, and make necessary adjustments.

2. Provide minimum 1 visit of 4 hours, excluding travel time, to train plant operators.

B. Complete and submit the following forms in Section 01 99 00:

1. Manufacturer's Installation Certification Form.

2. Manufacturer's Instruction Certification Form.

3.04 DEMONSTRATION

A. Comply with Section 01 81 00 and 01 82 50.

B. Coordination with Sampling Procedures

1. To facilitate the Owner's planned periodic sampling of raw water from the wet well, demonstration of the submersible pumps shall include the development and documentation of the procedures necessary to establish, maintain and cease flow to the sampling station depicted in the Drawings. Procedures to be evaluated include, but are not limited to, the following:

a. Configuration (i.e., opening and closing) of sluice gates to facilitate the removal of wet well contents without refilling.

b. Partial closure of the eccentric plug valve on the 4-inch discharge line, to increase the head observed by the pump(s) in order to ensure the hydraulic grade line reaches the elevation of the sampling station.

2. Contractor shall document valve and gate settings required to facilitate sampling, as well as the numbers of operator turns necessary to achieve them.

3. Contractor shall document a range of flow rates to be expected at the sampling station based on the available range of eccentric plug valve positions.

END OF SECTION

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SECTION 46 05 13

GENERAL REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General requirements applicable to mechanical equipment and systems.

B. Ensure mechanical equipment meets the requirements of this Section in addition to the specific requirements of the individual equipment specification Sections.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 01 61 11 – Seismic Anchorage and Bracing
3. Section 01 78 23 – Operation and Maintenance Data
4. Section 01 81 00 – Equipment and System Testing
5. Section 01 99 90 – Reference Forms
6. Section 09 96 00 – High Performance Coatings

1.03 GENERAL REQUIREMENTS

A. Equipment shall be of new construction and comply with the following requirements:

1. Designed for stresses that may occur during fabrication, transportation, erection, and during continuous or intermittent operations.
2. Adequately anchored, leveled, aligned, and ready for operation without binding or overloading of critical components or motors.
3. Installed with necessary appurtenances required for proper operation and installation in a neat and workmanlike manner.
4. Tested by factory trained service mechanics or engineers.

1.04 UNIT RESPONSIBILITY

A. Equipment systems shall be assembled as a unit by a single manufacturer responsible for the entire unit.

1. Responsibility extends to selecting components of the system to assure compatibility, proper operation, and compliance with specified performance requirements.
2. Unit responsibility does not relieve Contractor of responsibility to Owner for performance of the Work.

1.05 QUALITY ASSURANCE

A. Arrangement

1. The arrangement of equipment shown on the Drawings is based upon information available at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer.

2. Some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements.

3. Structural supports, foundations, connected piping, and valves shown may have to be altered to accommodate the equipment provided. Additional payment will not be made for such revisions and alterations.

1.06 SUBMITTALS

A. Comply with Section 01 33 00.

B. General: Provide separate submittals for each equipment item or group of related equipment items.

C. Equipment Anchorage: Submit anchor bolt sizing calculations.

D. Bearing Life Calculations: Submit bearing L-10 life calculations in accordance with ABMA requirements.

1.07 OPERATION AND MAINTENANCE MANUALS

A. Furnish operation and maintenance manuals for each equipment system in accordance with the Section 01 78 23 requirements.

1.08 PROTECTION DURING SHIPMENT

A. Shipping: Ship equipment in sealed, weather-tight, enclosed conveyances, and protected against damaging stresses during transport and handling.

B. Bearing Housings: Wrap or otherwise seal to prevent contamination by grit and dirt, and tape closed ventilation and other types of openings.

C. Repair any damaged materials to conform to the requirements of the Contract before the assembly is incorporated into the Work. The Contractor shall bear the costs arising out of dismantling, inspection, repair, and reassembly.

PART 2 - PRODUCTS

2.01 PIPING CONNECTIONS ON EQUIPMENT

A. Flanges on Equipment: Conform to dimensions and drilling specified in ANSI B16.1, Class 125 unless otherwise required by Division 40 pipe specifications or the Drawings.

B. Pipe Flanges: Conform to dimensions and drilling specified in AWWA C207, Class D, 125 lb flanges provided on connection pipe.

C. Threaded Flanges: Flat faced with standard taper pipe thread conforming to ANSI B1.20.1.

D. Pipe Threads: Conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.

E. Flange Assembly Bolts and Nuts

1. Heavy pattern, hexagonal head, stainless steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2.

2. Threads: Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

2.02 BEARINGS

A. Service: Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified.

B. Rating

1. L-10 Rating Life: Minimum 50,000 hours unless otherwise specified. Determine rating life using the maximum equipment operating speed.

2. Determine rating in accordance with the latest revisions of AFBMA Methods of Evaluating Load Ratings of Ball and Roller Bearings.

3. Where individual equipment Sections specify higher bearing life ratings, those requirements supersede the minimum bearing life specified above.

C. Grease Lubricated Bearings

1. Fit with easily accessible grease supply, flush, drain and relief fittings, except those bearings specified to be factory sealed and lubricated.

2. Extend non-accessible grease fittings to an easily accessible location using 1/4-inch diameter stainless steel tubing as an extension tube.

3. Grease supply fittings: Standard hydraulic Alemite or Zerk type.

D. Oil Lubricated Bearings

1. Equip with either a pressure lubricating system or a separate oil reservoir type system.

2. Size oil lubrication systems to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60°C.

3. Equip with a filler pipe and an external level indicator gage.

E. Incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature, or install appropriate shielding on bearings that are accessible to touch.

2.03 DRIVE COMPONENTS

A. V-Belt Drives

1. Design with sliding base or other suitable tension adjustment.

2. Design with service factor of at least 1.6 at maximum speed.

3. Statically balance sheaves. In addition, dynamically balance sheaves that will operate at peripheral speed of more than 5,500 feet per minute.

4. Belts: Provide anti-static belts when explosion-proof equipment or environment is specified.

B. Gear Reducers

1. Provide drives with nominal input horsepower rating equal to or greater than the nameplate horsepower of the drive motor.

2. Provide gear drives manufactured in accordance with AGMA Class II service requirements.

2.04 SHAFT COUPLINGS

A. Type and Rating: Non-lubricated, designed for a minimum of 50,000 hours operating life.

B. Equipment with a driver greater than 1/2 horsepower, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations.

C. Provide couplings recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.

D. Install couplings in conformance to the manufacturer's instructions.

2.05 GUARDS

A. Guards

1. Enclose exposed moving parts with guards that meet the requirements of federal and state OSHA requirements.

B. Materials

1. Fabricate guards of 14 gauge steel and expanded metal screen to provide visual inspection of moving parts without removal of the guard.

2. Galvanize after fabrication and paint with the equipment.

3. Fasteners: Type 304 stainless steel.

2.06 NAMEPLATES AND LIFTING EYES

A. Nameplates

1. Provide on each item of equipment with the specified equipment name or abbreviation and equipment number.

2. Engrave or stamp (not painted) on stainless steel and fastened to the equipment in an accessible location with stainless steel screws or drive pins.

B. Lifting Eyes

1. Provide on equipment weighing over 80 lbs.

2.07 SPARE PARTS AND LUBRICANTS

A. Spare Parts: Provide for each item of mechanical, electrical, and instrumentation equipment a supply of spare parts and special tools required for the starting, testing, adjustments, and initial operation. Pack spare parts required by individual equipment specifications:

1. Pack spare parts with individual weights less than 50 pounds in a heavily constructed painted wood box with hinged cover and a locking clasp.

2. Provide a typed inventory of spare parts stapled to the underside of the cover.

3. Tag and wrap each part in a waterproof container. Spare bearings shall be encapsulated in an airtight plastic film.

B. Lubricants: Provide for each item of mechanical equipment of the type recommended by the equipment manufacturer a supply of the lubricant for startup, testing, and initial operation.

1. Provide a list showing the required lubricants for each item of mechanical equipment. List estimated quantity of lubricant needed for a full year's operation, assuming the equipment will operate continuously.

2. Lubricants shall be products of the Owner's current lubricant supplier.

3. Limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types.

2.08 ANCHOR BOLTS

A. Size anchor bolts and concrete anchors for equipment in accordance with Section 01 61 11.

2.09 FACTORY APPLIED COATINGS

A. Ship each item of equipment to the site of the work with a shop applied prime coating prepared in accordance with the requirements of Section 09 96 00 and compatible with the finish coatings.

B. Finish Painting of Motors: Factory-apply finish coats using manufacturer's standard coating, unless otherwise specified in Section 09 96 00.

2.10 SPECIAL TOOLS AND ACCESSORIES

A. Furnish with each piece of equipment all tools, instruments, or accessories of a special nature that are required to assemble, disassemble, maintain, or repair any item of equipment.

1. Tag and mark each piece indicating their service and the piece of equipment for which their use is intended.

2. Include a list and description or pictorial representation of all special tools required for a given piece of equipment for insertion into the equipment operation and maintenance manual.

2.11 FASTENERS AND DIELECTRIC ISOLATION

A. Fasteners for Aluminum: Stainless steel.

B. Isolate steel surfaces, other than stainless steel, from aluminum with stainless steel, neoprene, non-metallic washers or other acceptable material.

C. Dissimilar Metals: Protect from galvanic corrosion by means of pressure tapes, coatings, or isolators.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install, align, and test each item of equipment within the tolerances recommended by the equipment manufacturer.

B. When specified in individual Sections, install and test equipment under the direction of installation engineers who have been factory trained by the equipment manufacturer.

C. Perform all work in accordance with manufacturer's recommendations.

3.02 QUALITY CONTROL

A. Test equipment in accordance with Section 01 81 00 and the individual equipment Section.

B. Furnish written certification from the equipment manufacturers that each item has been installed, aligned, and tested correctly and that the installation meets the manufacturer's requirements for efficient, trouble-free operation. Utilize Manufacturer’s Installation Certification Form provided in Section 01 99 90.

C. Equipment manufacturer’s certification shall not be construed as relieving the Contractor of his overall responsibility for this portion of the work.

END OF SECTION

SECTION 46 05 14

EQUIPMENT MOUNTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Equipment mounting requirements, including fabricated steel equipment bases, concrete equipment pads, supports, anchorage, and accessories.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01 33 00 – Submittals
2. Section 05 50 01 – Anchor Bolts and Anchoring Devices
3. Section 09 96 00 – High Performance Coatings

1.03 QUALITY ASSURANCE

A. Provide supports, anchorage, and equipment mounts that are sized and designed to resist the calculated forces and that are in accordance with the manufacturer's recommendations, the current International Building Code (IBC), and industry standards requirements.

1.04 DESIGN REQUIREMENTS

A. Design equipment mounts and anchorages to resist the minimum lateral force required by the latest edition of the IBC, the manufacturer of the equipment, or a lateral seismic force of 60% of the operating weight of the equipment, whichever is greater.

B. Equipment anchor bolt sizes shown on the Drawings are the minimum required size.

C. Equipment anchorage design and calculations shall be prepared and signed by a civil or structural engineer currently registered in the state where equipment is installed.

1.05 MOUNTING REQUIREMENTS

A. Mount equipment and driver on a common fabricated steel baseplate with ample rigidity to support equipment and maintain shaft alignment without excessive deflection.

B. Mount equipment baseplates on concrete equipment pads.

1.06 SUBMITTALS

A. Comply with Section 01 33 00.

B. Shop Drawings: Provide drawings of equipment bases and anchorage details.

C. Anchorage Calculations: Submit stamped and signed anchor bolt sizing calculations.

PART 2 - PRODUCTS

2.01 ANCHOR BOLTS AND CONCRETE ANCHORS

A. Provide anchor bolts and concrete anchors in accordance with Section 05 50 01.

2.02 CONCRETE EQUIPMENT PADS

A. Construct concrete pedestals at least 6 inches wider and longer than the steel or cast base so that the distance between the anchor bolts and the edge of concrete is at least 3 inches.

B. Unless otherwise shown or specified, all conduits, piping connections, drains, etc. shall be enclosed by the concrete base.

C. Shape concrete pedestals to drain away from the base.

D. Allow concrete to cure 14 days or until the concrete has cured to 75 percent of its specified compressive strength before placing equipment on the concrete pedestal.

E. Do not start equipment placed on the concrete pedestal until the concrete has cured for 28 days or to 100 percent of its specified compressive strength.

2.03 STRUCTURAL STEEL EQUIPMENT BASES

A. Provide structural steel bases with thickened steel pads for doweling.

1. Fabricate equipment base using continuous welds to seal seams and contact edges between steel members.

2. Grind welds smooth.

B. Design equipment bases with perimeter steel beams, intermediate stiffeners and baseplate.

1. Provide perimeter steel beams with minimum depth equal to 1/10th of the longest dimension of the base.

2. Beam depth need not exceed 14 inches provided that the baseplate deflection is kept within acceptable limits to minimize misalignment, as determined by the manufacturer.

C. Provide grout holes for the bases of equipment where vibration isolation is not specified.

D. Provide minimum 1-inch thick steel mounting baseplate for equipment with drivers 20 horsepower and larger.

E. Shop-apply prime coat prepared in accordance with the requirements of Section 09 96 00 and compatible with the finish coatings

PART 3 - EXECUTION

3.01 GENERAL

A. Connect piping to equipment with flexible connections and/or expansion joints such that the intended use of these joints is maintained in the piping system.

B. Coordinate the location of electrical conduit and piping penetrations within the concrete pad and equipment base.

1. Stub-up penetrations on the same side of the equipment as required for connection to the equipment.

2. Locate equipment drains for proper drainage away from equipment.

3.02 EQUIPMENT MOUNTING

A. Mount equipment on equipment baseplates using stainless steel shims so that equipment and driver are level in both directions and mounted within machined areas on baseplate. Do not use wedges to obtain level and alignment.

B. Utilize templates for placement of anchor bolts prior to placing concrete for equipment pad.

C. Apply a non-seize or non-galling compound on the threads of anchor bolts and concrete anchors.

3.03 SHAFT ALIGNMENT

A. After the complete unit has been installed on the equipment pad and leveled, check the factory shaft alignment by disassembling coupling and measuring angular and parallel orientations.

B. Use reverse-indicator dial or laser type alignment equipment to align shafts to within the manufacturer's required tolerance. Allow for thermal expansion, spacer coupling length and other factors that affect proper shaft alignment.

3.04 GROUTING EQUIOMENT BASED

A. After alignment has been completed, tighten anchor bolts and grout between equipment base and equipment pad. Use non-shrink and non-ferrous grout no less than 7/8 inch and no more than 1-5/8-inches thick.

B. Allow 48 hours for grout to harden and then remove jacking screws. Re-check torque on anchor bolts and re-check shaft alignment, making corrections as necessary.

END OF SECTION

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