

Executed Counterparts Counterpart No. _____ of _____

Including Addenda Nos. _____ through _____

CPA No. _____

Georgetown Wet Weather Treatment Station - Treatment Station

Contract No. C01025C17

**Funded in part by the
Washington State Department of Ecology**

Volume 5 of 23

Technical Specifications
(Division 15)

May 2017



King County

**Department of Natural Resources and Parks
Wastewater Treatment Division**



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Contract C01025C17

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DIVISION 15

MECHANICAL

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SECTION 15050

PIPING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies systems of process piping and general requirements for piping systems. Detailed Specifications for the components listed in the Piping System Specification Sheets (PIPESPEC) of this Section are found in other sections of Division 15. Use this Section in conjunction with those Sections.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ANSI B16.11	Forged Steel Fittings, Socket-Welding and Threaded
ASME A13.1	Scheme for the Identification of Piping Systems
ASME B1.20.1	Pipe Threads, General Purpose
ASME B16.3	Malleable-Iron Threaded Fittings Class 150 and 300
ASME B16.5	Pipe Flanges and Flanged Fittings, NPS 1/2 – NPS 24
ASME B16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
ASME B31.3	Process Piping
ASME B31.9	Building Services Piping
ASTM A53	Pipe, Steel, Black and Hot-Dipped Zinc-Coated, Welded and Seamless
ASTM A74	Cast Iron Soil Pipe and Fittings
ASTM A105	Forgings, Carbon Steel, for Piping Applications
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A197	Cupola Malleable Iron
ASTM A234	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A403	Wrought Austenitic Stainless Steel Piping Fittings
ASTM A888	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B88	Seamless Copper Water Tube
ASTM C1173	Flexible Transition Couplings for Underground Piping Systems
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 D2466	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3262	“Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D3517	“Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe
ASTM D5926	Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
ASTM F441	Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

<u>Reference</u>	<u>Title</u>
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast for Water or Other Liquids
AWWA C200	Steel Water Pipe - 6 Inches and Larger
AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C509	Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	Disinfecting Water Mains
CISPI 301	Specification Data for Hubless Cast Iron Sanitary System with No-Hub Pipe and Fittings
CISPI 310	Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Application.
EPA SDWA Section 1417(d)	Reduction of Lead in Drinking Water Act Requirements, Amendments to Safe Drinking Water Act (SDWA), effective January 4, 2014
MIL-H-13528B	Hydrochloric Acid, Inhibited, Rust Removing
MIL-STD-810	Environmental Engineering Considerations and Laboratory Tests
NACE RP-0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP-0286	Electrical Isolation of Cathodically Protected Pipelines
NFPA 13	Installation of Sprinkler Systems
NSF/ANSI Standard 61	Health effects criteria (Lead Content Compliance) for water system components
NSF/ANSI Standard 372	Lead Content Compliance Guidelines for water system components
UPC	Uniform Plumbing Code

B. Qualifications:

1. Design Professional:
 - a. Professional Engineer registered in the state of Washington.
 - b. Not less than five years' experience in the type of piping work required for this Contract. Documentation demonstrating qualifications shall be submitted.
 - c. Shall provide the design, inspection, and certification for the piping supports, anchors, seismic restraints, and provisions for control of pipe expansion and shall stamp the drawings and calculations.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Qualifications of the Design Professional to be charged with design, inspection and certification of pipe supports and seismic restraint systems including education, proof of registration, proof of insurance, and previous experience in performing this type of work. The documentation shall be sufficient to demonstrate compliance with the requirements of this Section.
- C. For each piping system, catalog cuts and other information for pipe, fittings, linings, coatings, cathodic protection, and valving to be used for each pipe size category.
- D. Certification that each length of pipe has been pressure tested and has satisfactorily passed such tests.

- E. Piping layouts and layout schedule showing pipeline locations for piping systems in that area with respect to structures, other piping and utilities (ductwork, conduits, etc.) and details and location of joints, anchors, supports, fittings, connections, penetrations, supports, valves, piping appurtenances, flexible couplings, cathodic protection equipment, manholes, and clean-outs as applicable. Piping submittals by the Contractor shall include all elements detailed in the Drawings, including restraint or expansion elements as well as complete piping runs. Drawings shall be original layouts by the Contractor; photocopies of Contract Drawings are not acceptable.
- F. Piping Installation Work Plan shall detail sequencing of buried pipe installation including strategies to address the following topics: coordination with duct bank and conduit installation, coordination with utility vaults installation, bedding and backfill sequencing for shared trenches, pipe floatation, shoring installation and removal for trench sections and at property boundary, dewatering and compaction. The plan shall address Contractor and Subcontractor sequencing, coordination and critical interface points. At a minimum the plan shall include a detailed sequencing for all sections in the Site Yard Piping Sections drawings. The plan shall include sequencing at interface points with building for piping, conduits, and duct banks.
- G. Design drawings and calculations for pipe supports and seismic restraints as specified in Section 15096 and 15097. The drawings and calculations shall be sealed by the Design Professional. Submittal drawings shall include locations of anchors, guides, and expansion joints for expansion control systems as specified in Section 15090.
- H. FM Global Review: Seismic sway bracing for gas piping 1 IN and larger in accordance with the more stringent of local code requirements and FM Global Property Loss Prevention Data Sheet 1-11, Fire Following Earthquakes.
 - 1. Submittal review time: 45 Days.
- I. A copy of related contract schematic, structural, and mechanical Drawings with piping, foundations, supports, and layout sizes and dimensions requiring Contractor confirmation marked.
- J. Restrained joint anchorage calculations for buried pipe required by this Section.
- K. Sample of each piping identification plastic marker.
- L. Sample of each detectable tracer tape marker.
- M. Inspection reports, authored and sealed by the Design Professional retained under this Section and submitted to the Project Representative each week, as specified in this Section. The Design Professional's final inspection report shall be submitted to the Project Representative before beneficial occupancy.

1.04 DEFINITIONS

- A. Pressure terms used in Section 15050 and elsewhere in Division 15 are defined as follows:
 - 1. Maximum: The greatest continuous pressure at which the piping system operates.
 - 2. Test: The hydrostatic pressure used to determine system acceptance.
 - 3. PSI: Pound-force per square inch.
 - 4. PSIG: Pound-force per square inch gauge, which is the pressure relative to atmospheric pressure.

1.05 DESIGN OF PIPING SYSTEMS

- A. Procedures: In addition to materials and labor required to construct piping systems, provide professional engineering services ("Design Professional") for the design and inspection of piping system work. The Contractor shall provide the final design, inspection, and certification for the piping supports and seismic restraints on this project. Pipe supports are specified under Section 15096. Seismic restraints are specified under Section 15097. Pipe expansion control systems are specified under Section 15090.
- B. Supports, seismic bracing, and hangers and other piping system mounting elements for piping 24-inch diameter and less are generally not indicated in the Drawings. Where a specific support, hanger guide, structural attachment, anchor, joint or seismic restraint detail for pipe 24-inch or less is shown, it shall be to indicate the required configuration or general arrangement to be developed by the Contractor's Design Professional. Hangers, supports, expansion provisions, and seismic restraints for piping larger than 24-inch as indicated in the Drawings.
- C. Qualifications: The design of pipe supports and seismic restraints shall be the product of a structural engineer (SE) retained by the Contractor and currently licensed to practice in the state of Washington. The Design Professional shall have not less than five years experience in the type of piping support, seismic restraint, and expansion control design work required for this project. This requirement, however, shall not construe as relieving the Contractor of overall responsibility for this portion of the work. Documentation demonstrating qualifications shall be submitted.
- D. Coordination with Drawings and Specifications: If a particular type of support, anchor, seismic restraint, or expansion element is indicated in the Drawings, those elements shall be incorporated into the Contractor's design. Piping submittals by the Contractor shall include all elements, including those portions directed by the Project Representative, as well as complete piping runs that include pipe anchorage and expansion joints. The Contractor's Design Professional shall, as part of the submittal process, notify the Project Representative if he believes any restraint or expansion element is incompatible with the overall piping system and its function.

1.06 WARRANTY

- A. For the work of this Section, provide warranties as described in the General Conditions, Section 00700, Subsection 7.9B, and provide normal commercial warranties available as described in the General Conditions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Unless otherwise specified, provide piping materials listed in the PIPESPEC, including pipe, gaskets, fittings, joint assemblies, connections, linings and coatings, conforming to detailed specifications for each type of pipe and piping appurtenance specified in other Sections of Division 15.
- B. Where temporary piping and valving are required, piping material and accessories shall be selected by the Contractor and submitted to the Project Representative for approval. Such piping shall be suitable for operation at the test pressure and maximum range of operating service temperature of the permanent piping system which the temporary piping is replacing, as specified in the PIPESPEC. Temporary piping shall be provided with supports at intervals which prevent sagging or liquid accumulation.
- C. Fittings and Coupling for grooved end piping systems shall be compatible and shall be furnished by the same manufacturer.

2.02 PIPING IDENTIFICATION

A. Plastic Coding Markers:

1. Comply with ASME A13.1.
2. Precoiled type that is easily removable.
3. Resistant to UV, petroleum based oils and grease.
4. Meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810.
5. Withstand a continuous operating temperature range of - 40 to 250 degrees F.
6. Shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic including directional arrows. Legends and arrows shall be subsurface printed on polyester and over laminated with Tedlar.
7. Acceptable Manufacturers:
 - a. Marking Services.
 - b. Brady Style.
 - c. Approved Equal.
8. Minimum marker lengths and letter heights:

OUTSIDE DIAMETER OF PIPE OR COVERING*	MINIMUM LENGTH OF MARKER	MINIMUM HEIGHT OF LETTERS
Less than 1-1/2-inch	8-inch	1/2-inch
1-1/2 to 3-inch	8-inch	1-1/8-inch
Greater than 3-inch	12-inch	2-1/4-inch

Note: * Outside diameter shall include insulation and protective wrapping.

9. Pipe Marker Legends:
 - a. Embossed with pipe symbol listed in Table A to indicate pipe service.
 - b. Indicate direction of flow with arrows. Use bidirectional arrows if appropriate for the pipeline.
 - c. Arrows and pipe symbol letters shall be the same size and color.
10. Color:
 - a. Background color shall match existing or shall be as specified in the Table A.
 - b. Legends and arrow color shall match existing or shall be white on blue, black, or red backgrounds; black on other color backgrounds.

B. Tracer Tape for Buried Pipelines:

1. Tracer tape shall be 6 inches wide, colored the same as the background colors as specified in Table A of this Section, specifically manufactured for marking underground pipelines, and made of inert plastic material suitable for direct burial.
2. Detectable tracer tape for non-ferrous and stainless steel pipe materials shall be 6 inches wide, specifically manufactured for marking underground utilities, and made of inert plastic material suitable for direct burial.
 - a. Detectable tracer tape shall incorporate solid aluminum foil, with thickness as necessary to enable detection from the finished grade with a metal detector (minimum 0.35 mil).
 - b. The aluminum foil shall be visible on the unprinted side of the tape, and encased in a protective, high visibility, inert polyethylene plastic jacket, colored the same as the background colors as specified in Table A of this Section. Laminate thickness shall be 5 mils minimum.
 - c. Clips for joining section of tape shall be tin or nickel-coated and furnished by the tape manufacturer.
3. A message shall be printed on the tape.
 - a. The message shall read "CAUTION CAUTION CAUTION _____ PIPE BURIED BELOW" with bold letters approximately 2 inches high for tracer tape and approximately 1-1/4 inches high for detectable tracer tape.
 - b. The blank shall be filled with the name of particular system fluid.
 - c. The message shall be printed at maximum intervals of 2 feet.

2.03 VALVES

- A. Valves of the same size and service shall be provided by a single valve manufacturer.
- B. Packing shall be non-asbestos material. Actual length of valves shall be within 1/16 inch (plus or minus) of the manufacturer's specified length.
- C. Flanges shall meet the requirement of ASME B16.5. See Section 15085 for connections to pipes.
- D. Push-on and mechanical joints shall meet the requirements of AWWA C111.
- E. Valve operators: Section 15140.

2.04 INSULATING FLANGES, COUPLINGS, AND UNIONS

- A. Flange Insulating Kits: 2-1/2 inches and Larger:
 - 1. Flanged, complete with bolt insulators, dielectric gasket, bolts, and nuts.
 - 2. In accordance with applicable piping material specified in Pipe Data Sheet. Complete assembly shall have ASME B31.9 or B31.3 rating equal to or higher than that of joint and pipeline.
 - 3. Galvanically compatible with piping.
 - 4. Resistant for intended exposure, operating temperatures, and products in pipeline.
 - 5. Gaskets: Full-face Type E with elastomeric sealing element. Sealing element shall be retained in a groove within retainer portion of gasket.
 - 6. Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA G-10 grade).
 - 7. Insulating Washers: Fiberglass reinforced epoxy (NEMA G-10 grade).
 - 8. Steel Washers: Plated, hot-rolled steel, 1/8 inch thick.
 - 9. Manufacturers:
 - a. Pipeline Seal and Insulator.
 - b. Advance Products and Systems.
 - c. Approved Equal.
- B. Flexible Insulated Couplings:
 - 1. Dresser; STAB-39.
 - 2. Baker Coupling Company, Inc.; Series 216.
 - 3. Approved Equal.
- C. Insulating Unions: Union Type, 2 inches and Smaller:
 - 1. Screwed or solder-joint.
 - 2. O-ring sealed with molded and bonded insulating bushing to union body.
 - 3. Manufactured by Central Plastics Co.
 - 4. Approved Equal.

2.05 FLANGED PIPE SPOOLS FOR FLOW TRANSMITTER MAINTENANCE

- A. Provide the following pipe spool sections for each size of the flow transmitter to be used during the transmitter removal and repair. The spool dimensions and flange patterns shall meet the flow transmitter requirement in Section 17212. The material, lining and coating shall meet the PIPESPEC herein.

Symbol	Pipe Size
TBS	8"
C3	8"
RS	16"
RS	20"
EFF	48"

PART 3 EXECUTION

3.01 GENERAL

- A. Submit Piping Installation Work Plan forty-five (45) days prior to starting excavation for buried pipe installation. This does not include encased pipe beneath buildings.
- B. Location:
 - 1. Provide piping as specified except for adjustments to accommodate architectural and structural features.
 - 2. Coordinate with HVAC and electrical construction.
- C. Potable Water Connections:
 - 1. Connect potable waterlines in accordance with municipal codes and ordinances, and laws and regulations of the State and City.
 - 2. Potable water system components shall utilize lead free materials as defined in accordance with EPA's Safe Drinking Water Act Section 1417 Requirements, effective January 4, 2014. Products shall meet NSF/ANSI Standard 61 or NSF/ANSI Standard 372. Refer to products listed in Annex G of NSF/ANSI Standard 61 or NSF/ANSI Standard 372.
 - 3. New water service installation and water service retirements will be completed by Seattle Public Utilities (SPU). Coordinate timing of water service installation and retirements with other Contract work. Notify Project Representative and SPU twenty-eight (28) days prior to needing service installations or retirements completed for project sequencing purposes. SPU will install temporary pavement patch. Contractor is responsible for permanent pavement restoration.
- D. Pipe Support, Anchorage and Bracing:
 - 1. Pipe supports for FRP ductwork shall meet the requirements of Section 13234.
 - 2. Support piping by anchor brackets, guides, saddles or hangers per Section 15096.
 - 3. Seismic anchorage and bracing: See Sections 01031 and 15097.
 - 4. Examples of supports, guides, saddles, hangers and structure attachments for general pipe support, expansion/contraction and for seismic bracing, as well as anchorage details, are available in the Drawings.
 - 5. The drawings do not attempt to show all required supports, hangers, or seismic braces. These items are shown only where special requirements exist or where necessary to convey a specific design intent.
 - 6. Where a specific type of support or anchorage is indicated in the Drawings, then only that type shall be used at that location.
 - 7. Pipe support anchorage shall meet the requirements of Section 05501 unless indicated in the Drawings otherwise.
 - 8. Pipe hangers, guides and saddles are generally not indicated in the Drawings.
 - 9. Locations and type of rigid pipe anchorage generally are indicated in the Drawings. Coordinate pipe layout, pipe supports, and seismic bracing with the pipe anchorage requirements indicated in the Drawings.
 - 10. Where not more specifically indicated in the Drawings, type of pipe support shall be in accordance with the requirements of Section 15096.
 - 11. Provide supports on each run at each change of direction.
 - 12. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
 - 13. Anchor piping with flexible connections and/or expansion joints such that the intended uses of these joints are maintained in the piping system.
 - 14. Unless otherwise specified, pipe support materials of construction shall meet the requirements of Section 15096.

- E. Anchorage for Buried Piping: Bends, tees and dead ends in buried pressure piping systems shall be anchored by means of restrained joints. Additional requirements for restrained joints are specified in the individual pipe material specifications. For conditions other than those indicated in the Drawings and specified, submit calculations showing the type of restrained joint proposed and the length of restrained joint. Concrete thrust blocks shall not be used unless specifically indicated in the Drawings.
- F. Bedding and Backfill: For buried piping in accordance with Division 2 Sections.
- G. Joint and Fitting Options: Pipe connection (joint and fitting) options for a particular piping system shall be as specified on the particular system PIPESPEC sheet. Takedown couplings shall be provided for piping systems in accordance with Section 15085. Takedown couplings shall be provided around equipment and at standard pipe lengths for straight runs of pipe. Continuous welding for straight runs of pipe is acceptable only where the individual PIPESPEC sheet allows welding as a connection option. Where connections are indicated in the Drawings, the connections shall be specifically where indicated; however, if several connection options are allowed for the particular piping system on the PIPESPEC sheet, then any option may be consistently used, for example, if flanged or grooved are acceptable and grooved are indicated in the Drawings, then flanged may be substituted. Integrity of rigid, non-rotating connections shall be maintained at valves and other equipment.
- H. Small Bore Utility Piping: Small bore (less than 3-inch) diameter pipe for utility (non-process) services (C1, C2, C3, C4, IA, SA, etc.) shall be field routed by the Contractor. Small bore utility piping is not shown on the drawings unless a specific pipe routing or configuration is to be provided. Distribution lines for small bore utility piping are shown on the drawings along with service connection routes to rooms/locations that require utility service piping. Small bore utility piping that must be drained to provide freeze protection shall be continuously sloped down to the drain.
- I. Connections to Existing Piping: Isolation valves, as specified in this Section, shall be installed at every location where new pipes connect to existing piping systems. Isolation valves shall be used to minimize existing system shutdowns and existing system interference with new pipeline testing.

3.02 PIPING AND VALVE IDENTIFICATION

- A. Pipe Coding: After application of the specified coating and insulation systems, identify exposed piping, including piping in ceiling spaces, pipe trenches, pipe chases and valve boxes with plastic markers as specified. 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, inside valve boxes and vaults, and at approximately 20-foot centers. Attach with stainless straps, plastic straps are not acceptable.
- B. Plastic Tracer Tape: A single line of tape shall be provided 2 feet above and parallel to each buried iron or steel pipe. For pipelines buried 8 feet or more below finished grade, provide a second line of tape 12 inches below finished grade, above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.
- C. Detectable Tracer Tape: A single line of tape shall be buried 6 to 12 inches below ground and above and parallel to each buried nonferrous and stainless steel pipe. For pipelines buried 8 feet or more below final grade, provide a second line of tape 2 feet above and parallel to each buried pipe. Tape shall be spread flat with message side up before backfilling.
- D. Magnetic Tracer Tape: A single line of tape shall be shall be buried 2 feet above and parallel to each buried nonferrous and stainless steel pipe.
- E. Valves: Stainless steel tags bearing the specified valve number stamped in 1/4-inch high letters.
 - 1. Flanged valves: Install on valve flanges in a position visible from floor level.

2. Flangeless valves 6 inches in diameter and smaller: Attach to the valve stem by 0.063 inch minimum stainless steel wire.
3. Flangeless valves 8 inches in diameter and larger: Attach to the valve body by self-tapping corrosion resistant metal screws.

3.03 PIPE INSTALLATION

A. Protection of Work:

1. Cover openings in piping, and temporarily seal to protect from contamination.
2. Protect materials and equipment from damage due to environmental conditions. Use protective cover, and protect from surface water by using raised platforms.
3. Protect unfinished work at end of each workday from damage, contamination and moisture by use of plugs, caps or covers.
4. Protect piping and valves from damage pending performance of system tests.

B. Installation:

1. Install piping parallel to walls. Clear obstructions, preserve headroom, and keep openings and passageways clear.
2. Should structural difficulties or other work prevent installation of pipes or setting of equipment at locations indicated, necessary minor deviations will be allowed, as approved by the Project Representative.
3. Expanding or swaging of tubing to fit (Iron Pipe Size) fitting sockets will not be permitted.
4. Use reducing fittings where change in pipe size occurs.
5. Use couplings only where required pipe runs between fittings are longer than standard length of pipe being used.
6. For all coupling systems that have the potential to allow a rotation, the couplings or flange coupling adapters shall be installed in a neutral position so that they have the required rotational capability for the anticipated ground settlement.
7. Make exposed polished or enameled connections to fixtures or equipment with special care to avoid damage to finished surfaces.
8. Make changes in direction only with fittings.
9. Provide expansion loops or bends where indicated to allow for proper pipe expansion. Construct bends with long radius welded fittings.
10. Use proper length bolts for each size flange on flanged connections. Bolts with excessive length of exposed threads will not be permitted. Minimum of 3 full threads shall be exposed beyond nut after tightening assembly.
11. Prevent entry of foreign matter during handling, assembling and installation. Use compressed air, wire brush, solvent and other acceptable means to remove residual scale, dirt and other foreign matter from interior of piping before final connections are made. Protect open ends of pipe by capping, plugging or other acceptable means.
12. Install piping with sufficient pitch to ensure adequate drainage and venting.
13. Provide unions or flanges in piping connections to equipment.
14. Electrically isolate connections between dissimilar metal piping with dielectric couplings or fittings.
15. Install class of piping as indicated.
16. Do not run water piping over electric switchboards, transformers or electric motor starters.
17. Protect against external corrosion pipes which pass through, under or otherwise in contact with soil, cinders, concrete or other corrosive material. Protect by protective wrappings.
18. Specification Section 01450 identifies corrosive areas where special pipe materials, pipe supports, or coatings may be required.
19. Flange bolt holes shall be "Two-Holed" to maintain consistent flange bolt hole positions along the entire length or run of the pipe. (Flange bolt holes shall straddle the vertical and horizontal centerline of the flange with flange bolt holes equidistant from the flange centerline.) For pipe installed with a horizontal axis, flange bolt holes shall be positioned so that the vertical centerline of the flange face bisects the arc between flange bolt holes. For pipe installed with a vertical axis, flange bolt holes shall be positioned so that the horizontal centerline of the flange face bisects the arc between flange bolt holes and is perpendicular to the closest structural wall.

- C. Sewer and Waste Piping:
 - 1. Run horizontal drainage piping as straight as practicable and at uniform pitch.
 - 2. Install pipe 3 inches or less in diameter with pitch of not less than 1/4-inch per foot unless otherwise indicated in the Drawings.
 - 3. Install pipe larger than 3-inch diameter with pitch of not less than 1/6-inch per foot unless otherwise indicated in the Drawings or required by the Uniform Plumbing Code.
 - 4. Install sanitary sewers within or adjacent to any building or structure at slope which will produce computed velocity of not less than 2 feet per second.

- D. Cast Iron Soil Piping:
 - 1. For bell and spigot pipe, make joints with neoprene push-on gasket.
 - 2. For neoprene gasketed plain spigot end pipe, insert gaskets, lubricate inside of gaskets and outside of pipe, and join together with suitable tool as recommended by manufacturer.
 - 3. For hubless pipe, install in accordance with CISPI and government plumbing codes.

- E. Copper Piping:
 - 1. Make joints with 95-5 tin-antimony.
 - 2. Clean outside of tube and inside of fitting at point of contact before joining. Take care to prevent overheating of tube and fitting before joining.

- F. Wall Penetrations for Plastic Piping (HDPE, PVC, CPVC, and PP).
 - 1. Below grade and submerged wall or floor penetrations using plastic pipe are not permitted. Contact the Project Representative for resolution if any below grade or submerged wall or floor penetrations are indicated in the Drawings.
 - 2. Plastic pipe penetrations through concrete shall consist of plastic pipe penetrating walls or floors through sleeves embedded in concrete. The annular space between the pipe and the embedded sleeve shall be sealed as indicated in the specified wall penetration detail.

- G. Pipe Joints and Connections:
 - 1. Cut pipe with appropriate tool and deburr. Make joints tight. Test and remake leaky joints with new materials. Do not use thread cement or caulking to remake joints. Do not use sharp-toothed wrench in making up brass pipe or chrome-plated items.
 - 2. Provide thread forms and length in accordance with ASME standards. Use lubricant or sealant on male threads suitable for pipe service.
 - 3. Clean joint before soldering. Use appropriate flux and alloy for operating temperature level as indicated.
 - 4. Apply standard rules for welding of pipe joints as contained in ASME Standard Code for pressure piping including welding procedures, qualification of welders and testing. Follow applicable local safety codes.
 - 5. Provide gasket coated with recommended lubricant between contact faces of flanges.

- H. Unions, Flanges and Gaskets:
 - 1. Provide unions where indicated and at each threaded or soldered connection to equipment, tanks and valves with the following exceptions:
 - a. Only one union is required at each manually operated threaded valve.
 - b. None required at compression stops.
 - 2. Locate unions so piping can be easily disconnected for removal of equipment or valve.
 - 3. Provide flanges at each flanged connection to equipment and valves in accordance to Section 15085. Tighten fastener system to indicated torque.

- I. Insulating Flanges, Couplings, and Unions:
 - 1. Applications:
 - a. Dissimilar metal piping connections.
 - b. Cathodically protected piping penetrations to buildings or structures (joint-bonded ductile iron piping penetrates buildings or structures).
 - c. Where required for electrically insulated connection.

2. Pipe installation:
 - a. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
 - b. Align and install insulating joints according to manufacturer's recommendations to avoid damaging insulating materials.
- J. Pipe Hangers and Supports:
1. Provide piping systems with anchorages, sway braces, guides and supports as required by applicable portions of ASME B31.
 2. Provide support for vertical and horizontal loads, including vibration imposed loads.
 3. Necessary hangers and supports including beam and purlin clamps, rods, pipe rolls, angles, channels and plates as well as any changed from indicated design, shall have prior approval of the Project Representative.
 4. Use of building structural steel for supporting hangers will be permitted only where indicated or approved by Project Representative. Do not weld transversely across tension flange or any member under stress, use bracing, girts and other secondary members for support, nor burn or drill holes in building steel.
 5. Support vertical piping with approved steel brackets to prevent swaying, sagging, vibration and resonance. Allow for thermal expansion between supports or anchors. Do not use flat steel strap hangers.
 6. Do not support piping by wire, rope, strap, chain, wood or similar devices.
 7. Provide pipe hangers of same size, or nearest commercial size available, as pipe or tubing on which they are to be used. Allow for thickness of insulation in sizing hangers.
 8. Supporting structures, including supporting frames, anchors and guides common to mechanical and electrical work, shall be submitted and have the prior approval of the Project Representative.
 9. Use adjustable iron hangers for 1-1/4 inches and smaller pipe, and clevis type for 1-1/2 inches and larger pipe. Where copper tubing is directly supported, use copper-plated hangers.
 10. Protect dissimilar metals by wrapping pipe with 1/16 inch thick neoprene.

3.04 TESTING

- A. In addition to any testing herein, perform testing for the product or system consistent with the requirements of Section 01660, the applicable codes, and the manufacturers' current quality assurance program.
- B. General:
 1. Upon completion of piping, but prior to application of insulation on exposed piping, test the piping systems. Pressures, media and test durations shall be as specified in the PIPESPEC. Equipment which may be damaged by the specified test conditions shall be isolated. Isolate pipe sections which have different pipe materials or are tested in different methods. Testing shall be performed using calibrated test gages and calibrated volumetric measuring equipment to determine leakage rates. Each test gage shall be selected so that the specified test pressure falls within the upper half of the gage's range. Unless otherwise specified, completely assemble and test new piping systems prior to connection to existing pipe systems. Notify the Project Representative a minimum of one hour prior to each test.
 2. Unless otherwise specified, testing, as specified herein, shall include existing piping systems which connect with new pipe systems. Existing pipe shall be tested to the nearest existing valve. Any piping which fails the test shall be repaired. Repair of existing piping will be considered and paid for as extra work.
 3. Testing of the ribbon anode and electrical isolation effectiveness shall include the following. After installation of electrical isolation equipment, effectiveness shall be judged in accordance with NACE RP-0286. The magnesium ribbon anode installation shall be judged in accordance with NACE RP-0169. No practical testing of the zinc ribbon mode is possible because the anode is isolated from the environment until the polyethylene wrap is compromised.

- C. Gas and Air Systems:
 1. The allowable leakage rate for hazardous gas systems, insulated systems, and systems tested with water shall be zero at the specified test pressure throughout the specified test period. Hazardous gas systems shall include oxygen and sludge gas systems. Oxygen systems shall be tested using dry, clean nitrogen gas at constant temperature.
 2. The allowable leakage rate for other systems tested with air shall be based on a maximum pressure drop of 5 percent of the specified test pressure for the duration of the period. Prior to starting a test interval using air, the air shall be at ambient temperature and specified test pressure.
- D. Liquid Systems:
 1. Testing medium and procedures for hydraulic and lube oil systems are specified in this Section.
 2. The allowable leakage rate for other systems shall be zero at the specified test pressure throughout the specified duration.
- E. Nitrogen or Air Pressure Testing:
 1. Nitrogen gas or oil-free dry air may be used to test steel lines. Testing consists of gradually introducing nitrogen gas or dry air up to 50 PSI and maintaining this pressure while testing the line for leaks with soapy water. When the system is free from leaks at this pressure, the test pressure shall then be increased in increments of 50 PSI up to a maximum of 150 PSI. At each stepped increase in pressure, check for leaks and take corrective action as necessary. When the system is free from leaks at the final test pressure, the system shall then be depressurized, the test source disconnected, and the system capped to prevent the entrance of water.
 2. For testing with nitrogen gas, use cylinders of dry high purity nitrogen gas, nitrogen-handling cylinder mounted pressure regulator 0 to 300 PSI, and necessary fittings and adapters to complete connection between the source and system header. Pressure regulator shall be self-relieving type which vents to the atmosphere and include a throttling valve.
 3. For testing with air, provide oil-free air with a relative humidity of zero. Fittings, adapters, and accessories, pressure regulator and throttling valve shall be suitable for pressure testing with air and rated for 300 PSI service.
- F. Drains: Drain systems, other than pumped drain systems, shall be tested in accordance with UPC.

3.05 HYDROSTATIC TESTING OF PIPELINES AND APPURTENANCES

- A. Water for testing pipelines shall be furnished by the Contractor. Be responsible to convey the water from the source to the points of use.
- B. A testing plan and schedule, including method for water conveyance, control, and disposal, and disinfection (if applicable) shall be submitted in writing for approval.
- C. Pressure pipelines shall be tested; those for potable water shall be disinfected, chlorinating and testing operations shall be performed in the presence of the Project Representative.
- D. Disposal of flushing water and water containing chlorine shall be in accordance with Section 02271.
- E. Determine and select test equipment, temporary valves, bulkheads, and other water control equipment
- F. Pipeline 24-inches diameter and larger shall be video inspected in accordance with Section 02761 prior to hydrostatic testing.
- G. Prior to hydrostatic testing, pipelines shall be flushed.
- H. Test pipelines in sections not to exceed one mile in length.

- I. The test shall be made by closing valves when available or by placing bulkheads and filling the line slowly with water.
- J. Be responsible for ascertaining that test bulkheads, valves, concrete thrust blocking or other means of restraint are suitable to resist the thrust of the test pressure without damage to or movement of the adjacent pipe.
- K. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment.
- L. Remove or protect pipeline-mounted devices that may be damaged by the test pressure.
- M. Provide sufficient means to allow trapped air to exit. Air relief valves shall be open during pipeline filling.
- N. Pipeline shall be filled at a rate which will not cause surges or exceed the rate at which the air can be released through the release valves.
- O. Air within the pipeline shall be allowed to escape completely.
- P. Differential pressure across the orifices in the air release valves shall not be allowed to exceed five psi at any time during filling.
- Q. After the pipeline has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining to absorb water and to allow the escape of air from air pockets.
- R. During this period, bulkheads, valves, and connections shall be examined for leaks.
- S. If leaks are found, corrective measures satisfactory to the Project Representative shall be taken.
- T. Hydrostatic test shall consist of holding the indicated test pressure on the pipeline segment for a period of four hours.
- U. Test pressure for piping shall be as specified in the PIPESPEC for the type and size of piping being tested.
- V. Test pressure shall be achieved for all elevations along the pipeline.
- W. No pressure test will be required for a reservoir overflow line.
- X. Leaks that appear during testing shall be repaired in a manner acceptable to the Project Representative. If a leak in buried pipeline is detected, it shall be excavated, located, repaired and retested until pipeline passes the pressure test requirements.
- Y. Add water to restore the test pressure if the pressure decreases five psi below test pressure during the test period.
- Z. Connection to the existing wastewater system shall be made following successful completion of hydrostatic testing.

3.06 CLEANING AND FLUSHING

- A. General: Piping systems shall be cleaned following completion of testing and prior to connection to operating, control, regulating, or instrumentation equipment. The Contractor may, at its option, clean and test sections of buried or exposed piping systems. Use of this procedure, however, will not waive the requirement for a full pressure test of the completed system. Unless specified otherwise, piping 24 inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system. Piping larger than 24 inches in diameter may be cleaned manually or with a cleaning ball or swab. Upon completion of the cleaning, connect the piping systems to related equipment and structures.
- B. Temporary Screens:
 - 1. Upon completion of the cleaning, connect the piping systems to related process equipment and structures. Temporary screens, provided with locator tabs which remain visible from the outside when the screens are in place, shall be inserted in pipelines at the suction of pumps and compressors in accordance with the following table:

Equipment Suction or Piping Size (inches)	Maximum Screen Opening (inches)
0 to 1	1/16
1-1/4 to 3	1/4
3-1/2 to 6	1/2
Over 6	1

- 2. Maintain the screens during testing, initial start-up, and initial operating phases of the commissioning process. In special cases, screens may be removed as required for performance tests. Remove the temporary screens and make the final piping connections after the screens have remained clean for at least 24 consecutive hours of operation. Systems handling solids are exempt.
- C. Gas and Air Systems: Unless otherwise specified, gas and air system piping 6 inches in diameter and smaller shall be blown out, using air or the testing medium specified. Piping larger than 6 inches shall be cleaned by having a swab or "pig" drawn through the separate reaches of pipe. After connection to the equipment, it shall then be blown out using the equipment. Upon completion of cleaning, the piping shall be drained and dried with an air stream. Natural gas system shall be purged with nitrogen and a nitrogen pad maintained at 10 PSI until put in service.
- D. Liquid Systems: After completion of cleaning, liquid systems, unless otherwise specified, shall be flushed with clean water. With temporary screens in place, the liquid shall be circulated through the piping system using connected equipment for a minimum period of 15 minutes and until no debris is collected on the screens. .
- E. Potable Water Systems: Potable water piping systems shall be flushed and disinfected in accordance with AWWA C600 and C651.

3.07 PIPE SUPPORT INSPECTION

- A. The County will provide special inspection in accordance with Section 01031 for certain piping seismic anchorage and bracing system as indicated in the Drawings.
- B. Upon completion of construction, but prior to beneficial occupancy of the piping systems by the County, the Design Professional shall conduct a detailed final inspection and furnish the Project Representative with a final report certifying that all work has been accomplished in accordance with applicable requirements. All reports shall bear the Design Professional's seal and signature in accordance with the laws, rules, and regulations of the state of Washington.

3.08 PIPING SPECIFICATION SHEETS (PIPESPEC)

- A. Piping and valves for groupings of similar plant processes or types of service lines are specified on individual piping specification sheets. Piping systems are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of systems is identified by a piping system number. Piping systems specified and indicated in the Drawings are arranged by designated symbols (abbreviations) as indicated in Table A. Table A also indicates the system number, fluid category, and pipe marker background color of each service.
- B. Unless otherwise indicated in the Drawings or Drawing schedule, piping system materials, fittings and appurtenances are subject to requirements of specific piping specification sheets.
- C. Coating and lining for valves shall be in the same as the connection piping at the valves and meet requirements of Sections 09900 and 09901, except if specified in PIPESPEC.

Table A – piping systems

Symbol Color	Service	System	Fluid Category	Pipe Marker Background Color
COAG	Coagulant	19	Chemical	Yellow
CD	Chemical Drain	25	Chemical Drain/Vent	Yellow
CDD	Condensate Drain	24	Condensate Water	Green
D	Drain	24	Drain/Vent	Green
DR	Process Drain	24A	Drain/Vent	Green
DF	Defoamer	19	Chemical	Yellow
EE	Engine Exhaust	31	High Temperature Gas	Yellow
EFF	Effluent	13	Effluent	Green
EFFR	Effluent Recirculation	13	Effluent Recirculation	Green
FA	Foul Air	22	Foul Air	Yellow
FOR	Fuel Oil Return	18	Petroleum	White
FOS	Fuel Oil Supply	18	Petroleum	White
FP	Fire Protection	33	Water	Red
FV	Fuel Vent	18	Petroleum	White
IA	Instrument Air	2	Air	Orange
MO	Mineral Oil	19	Chemical	Yellow
NaOH	Sodium Hydroxide	19	Chemical	Yellow
NG	Natural Gas	5	Gas	Yellow
OF	Overflow	19	Chemical	Yellow
PDR	Process Basin Drain	24B	Wastewater	Green
POL	Polymer	19	Chemical	Yellow
PS	Primary Solids	16	Sludge/Scum	Green
RD	Roof Drain	24	Drain/Vent	Green
RS	Raw Sewage	12	Wastewater	Green
SA	Service Air	2	Air	Orange
SAM	Sample	21	Wastewater	Green
SN	Supernatant	13	Wastewater	Green
SPA	Supply Air	22	Supply Air (odor control)	Yellow
SS	Sanitary Sewer	28	Wastewater	Green
SSL	Sand Slurry	16	Sludge/Scum	Green
TA	Treated Air	22	Foul Air (treated)	Yellow
TBS	Thickened Bottom Sludge	16	Sludge/Scum	Green
V	Vent	24	Drain/Vent	Yellow
VC	Chemical Vent	25	Drain/Vent	Yellow

Symbol Color	Service	System	Fluid Category	Pipe Marker Background Color
Utility Water Systems				
C1	Domestic Potable Water	7A	Water	Blue
C2	Nonpotable Water City Water	7	Water	Green
C3	No. 3 Water	7	Water	Green
C4	Landscaping Irrigation	9	Water	Green
HW	Potable Hot Water	7A	Water	Green
HWR	Hot Water Recirculation	7A	Water	Green
TW	Tepid Water	7A	Water	Green

3.09 PIPESPEC - PIPING SYSTEM 2

Piping Symbol / Service:	IA – Instrument Air SA – Service Air
Test Requirements:	
Test Medium:	Water, as specified in this Section
Test Pressure:	150 PSI
Duration:	120 minutes
Leakage:	Zero, as specified in this Section
Gasket Requirements:	
Flanged:	N/A
Push on/Mechanical coupling:	N/A
Exposed Pipe and Valves:	
(See Drawings for pipe size and valve type)	
<u>(1/2" and smaller, indoor dry, indoor wet, and outdoor areas)</u>	
Pipe (Ref. Section 15066.):	Copper tube: ASTM B88, Type L, drawn. Connections: brass compression type, unions at equipment and valves. Fittings: brass compression type, Swagelok, Gyrolok, or Approved Equal. Lining: None. Coating: None.
<u>(3/4" through 2 1/2", indoor dry, indoor wet, and outdoor areas)</u>	
Pipe (Ref. Section 15066):	Copper tube: ASTM B88, Type L, drawn. Connections: solder type with threaded adapters for valves, unions at equipment and valves. Fittings: wrought copper or bronze, ASME B16.22. Lining: None. Coating: None.
<u>(2 1/2" and smaller, indoor dry, indoor wet, and outdoor areas)</u>	
Valves:	Ball valves: Ref. Section 15104. Swing check valves: Ref. Section 15150.
<u>(1/2" through 2 1/2", all areas)</u>	
Pipe (Ref. Section 15067):	Stainless steel: ASTM A312, Type 316, Schedule 40S. Connections: taper threaded, ASME B1.20.1, unions at equipment and valves. Fittings: ASTM A403, material, ends and wall thickness to match pipe. Lining: None. Coating: None.
Valves:	Ball valves: Ref. Section 15104. Swing check valves: Ref. Sections 15110 and 15150.
Buried and Encased Pipe and Valves:	
(See Drawings for pipe size and valve type. No coatings on encased pipe.)	
<u>(2 1/2" and smaller)</u>	
Pipe (Ref. Section 15066):	Copper tube: ASTM B88, Type K, annealed or drawn. Connections: solder type. Fittings: wrought copper or bronze, ASME B16.22. Lining: None. Coating: None.
<u>(2 1/2" and smaller)</u>	
Valves:	Ball valves: same as exposed with extension stem and valve box. Ref. Section 15104.
Remarks:	

Piping Symbol / Service:	IA – Instrument Air SA – Service Air
<ol style="list-style-type: none"> 1. See Section 01450 for area corrosion classification. 2. Piping between compressors and aftercoolers shall be insulated in accordance with Section 15260. 3. Lateral connections shall be made in the top half of the main line. Provide drip legs with valves at low points in the piping system. 4. Combination filter/regulator with gauge shall be Balcrank 3260-xx, or Approved Equal, 0-175-psig reduced pressure range, 175-psi-maximum supply pressure, 120 degrees F maximum operating temperature, metal bowls, sight-glass, 0-200-psi pressure gauge, automatic filter drain. Size and location shall be as indicated in Drawings for compressed air stations. 5. Quick-connect coupling shall be Dixon Air King, or Approved Equal. 6. Provide a PVC sleeve or polyethylene wrap for all copper piping encased or in contact with concrete. Minimum wall thickness of wrap shall be 0.025 inch. 7. Bubbler Pipes and Valves: stainless steel, per Section 17211. 	

3.10 PIPESPEC - PIPING SYSTEM 5

Piping Symbol / Service:	NG – Natural Gas
Test Requirements:	
Test Medium:	Air or Nitrogen per International Fuel Gas Code.
Test Pressure:	80 PSI
Duration:	120 minutes
Leakage:	Zero, as specified in this Section
Gasket Requirements:	
Flanged:	N/A.
Push on/Mechanical coupling:	N/A
Exposed Pipe and Valves:	
(See Drawings for pipe size and valve type.)	
(2" and smaller)	
Pipe (Ref. Section 15061):	Steel: ASTM A106, seamless, Grade B, black. Connections: Taper threaded, ASME B1.20.1, unions at equipment and valves. Fittings: malleable iron, ASTM A197, ASME B16.3, Class 150; ends to match pipe. Lining: None. Coating: Ref. Section 15061.
Valves:	Ball valves, Ref. Section 15104. Swing check valves, Ref. Section 15150.
Buried and Encased Pipe and Valves:	
(See Drawings for pipe size and valve type. No coatings on encased pipe.)	
(2" and smaller)	
Pipe (Ref. Section 15064):	Polyethylene (PE): ASTM D2513. Connections: Ref. Section 15064. Fittings: Ref. Section 15064. Lining: None. Coating: None.
Valves:	Ball valves, same as exposed with extension stem and valve box. Ref. Section 15104.
<u>Remarks:</u>	
1. See Section 01450 for area corrosion classification.	

3.11 PIPESPEC - PIPING SYSTEM 7

Piping Symbol / Service:		C2 – Nonpotable City Water C3 – No. 3 Water (Plant Effluent)
Test Requirements:		
Medium:	Water, as specified in this Section.	
Pressure:	150 PSI. See Remarks for Seal Water. C3 – 30 PSI	
Duration:	120 minutes	
Leakage:	Zero, as specified in this Section	
Gasket Requirements:		
Flange:	Steel: Rubber or Neoprene, AWWA C207. HDPE: Ref. Section 15065.	
Push-On/Mech Cpl:	EPDM or neoprene.	
Exposed Pipes and Valves:		
(See Drawings for pipe size and valve type)		
<u>(1" and smaller)</u>		
Pipe (Ref. Section 15066):	Copper tube: ASTM B88, Type L, drawn. Connections: solder or threaded or flanged adapters for valves, unions at equipment and valves. Fittings: wrought copper or bronze, ASME B16.22. Lining: None. Coating: None.	
<u>(1 1/2" through 2 1/2")</u>		
Pipe (Ref. Section 15064):	PVC: ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch. 80. Connections: Plain end; solvent cement weld, flange for valves 3 inch and larger, unions at equipment and valves smaller than 3". Fittings: PVC, ASTM D2467, Sch. 80, socket type, solvent cement weld. Lining: None. Coating: Ref. Section 15064.	
<u>(3" through 10")</u>		
Pipe (Ref. Section 15061):	Steel: ASTM A53, seamless, Grade B, black. Connections: butt weld, grooved mechanical pipe coupling or flanged. Fittings: malleable iron, ductile iron, or steel; ends to match pipe. Lining: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches. Coating: Ref. Section 15061.	
<u>(2 1/2" and smaller)</u>		
Valves:	Ball valves, Ref. Section 15104. Gate valves, Ref. Section 15101. Swing Check valves, Ref. Section 15150.	
<u>(3" through 8")</u>		
Valves:	Butterfly valves, Ref. Section 15103. Swing Check valves, Ref. Section 15111	

Piping Symbol / Service:		C2 – Nonpotable City Water C3 – No. 3 Water (Plant Effluent)
Buried and Submerged Pipes and Valves:		
(See Drawings for pipe size and valve type)		
(1 1/2" and smaller)		
Pipe (Ref. Section 15066):	Copper tube: ASTM B88, Type K, annealed, with polyethylene tape coating.	
	Connections: solder or threaded or flanged adapters for valves.	
	Fittings: wrought copper or bronze, ASME B16.22.	
	Lining: None.	
	Coating: None.	
(2" through 10")		
Pipe (Ref. Section 15065):	High Density Polyethylene (HDPE): ASTM D3350. See Remark 10 & 11.	
	Connections: Butt fusion welded with flanged adapters for valves.	
	Fittings: Ends and SDR to match pipe.	
	Lining: None.	
	Coating: None.	
(1 1/2" and smaller)		
Valves:	Ball valves, same as exposed with extension stem and valve box. Ref. Section 15104.	
	Gate valves, same as exposed with extension stem and valve box. Ref. Section 15101.	
(2" through 8")		
Valves:	Resilient seal gate valves, with extension stem and valve box. See Remarks. Ref. Section 15101.	
Encased Pipe and Flexible Connection for Steel Pipe:		
(See Drawings for pipe size)		
(2" through 10")		
Pipe (Ref. Section 15061):	Steel: ASTM A53, ERW, Grade B, black. See Remark 9.	
	Connections: Plain end butt welded or slip joint fillet welded.	
	Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150; ends to match pipe.	
	Lining: Cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches.	
	Coating: None. (No coating on the encased pipes.)	
Remarks:		
<ol style="list-style-type: none"> See Section 01450 for area corrosion classification. Provide protective coatings, joint bonding, electrical isolation, and galvanic anode cathodic protection system as indicated for ferrous metal pipe. Manual air vents shall be provided at the high points and manual drains shall be provided at the low points of each reach of pipeline as specified in this Section and/or indicated in the Drawings. 2" and smaller vent pipes, drain pipes and instrumentation connecting pipes on C3 piping system shall be schedule 40 black carbon steel pipe. Piping installed over suspended ceilings shall be insulated for condensation control in accordance with Section 15260. Resilient seal gate valves shall be iron body, bronze mounted, and non-rising stem conforming to AWWA C509. Valves shall be equipped with a 2-inch operating nut and "O" ring stem seals. Provide a PVC sleeve or polyethylene wrap for all copper piping encased or in contact with concrete. Minimum wall thickness of wrap shall be 0.025 inch. Butt weld connections are not permitted with lined pipe unless coatings and linings can be repaired. Where stainless steel is called out on drawings, shall be as per specification Section 15067. Suction pipes of C3 pumps inside the wet well shall be cement lined black steel pipe and coated in accordance with Section 15061. 		

Piping Symbol / Service:

C2 – Nonpotable City Water

C3 – No. 3 Water (Plant Effluent)

11. C3 diffuser pipes shall be made of SDR 11 HDPE pipes.

3.12 PIPESPEC - PIPING SYSTEM 7A

Piping Symbol / Service:	C1 – Potable Water HW – Hot Water (potable) HWR - Hot Recirculating Water (potable) TW – Tepid Water
Test Requirements:	
Medium:	Water, as specified in this Section.
Pressure:	150 PSI
Duration:	120 minutes
Leakage:	Zero, as specified in this Section
Gasket Requirements:	
Flange:	Steel: Rubber or Neoprene, AWWA C207.
Push-On/Mech Cpl:	EPDM or neoprene
Exposed Pipes and Valves:	
(See Drawings for pipe size and valve type)	
(2 1/2" and smaller)	
Pipe (Ref. Section 15066):	Copper tube: ASTM B88, Type L, drawn. Connections: solder or threaded or flanged adapters for valves. Fittings: wrought copper or bronze, ASME B16.22. Lining: None. Coating: None.
Valves:	Ball valves: Ref. Section 15104. Gate valves: Ref. Section 15101. Swing Check valves: Ref. Section 15150.
(3" through 8)	
Pipe (Ref. Section 15061):	Steel: ASTM A53, seamless, Grade B, black. Connections: butt weld, grooved mech pipe coupling or flanged. Fittings: malleable iron, ductile iron, or steel; ends to match pipe. Lining: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches. Coating: Ref. Section 15061.
Valves:	Ball valves: Ref. Section 15104.
Buried Pipes and Valves:	
(See Drawings for pipe size and valve type. No coating on encased pipes.)	
(2 1/2" and smaller)	
Pipe (Ref. Section 15066):	Copper tube: ASTM B88, Type K, annealed, with polyethylene tape coating. Connections: solder or threaded or flanged adapters for valves. Fittings: wrought copper or bronze, ASME B16.22. Lining: None. Coating: None.
Valves:	Ball valves: with extension stem and valve box. Ref. Section 15104. Gate valves: same as exposed with extension stem and valve box. Ref. Section 15101.
(3" through 8")	
Pipe (Ref. Section 15062):	Ductile iron: Class 53, AWWA/ANSI C151/A21.51. Connections: Push-on restrained joint. Flanged at valves. Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron, or AWWA/ANSI C153/A21.53 ductile iron compact

Piping Symbol / Service:	C1 – Potable Water HW – Hot Water (potable) HWR - Hot Recirculating Water (potable) TW – Tepid Water
	fittings, ends to match pipe.
	Lining: cement mortar.
	Coating: Bituminous.
	Polyethylene encasement.
Valves:	Ball valves: with extension stem and valve box. Ref. Section 15104.
	Resilient seal gate valves: with extension stem and valve box. See Remarks.
Encased Pipe and Flexible Connection for Steel Pipe:	
(See Drawings for pipe size)	
(2" through 10")	
Pipe (Ref. Section 15061):	Steel: ASTM A53, ERW, Grade B, black. See Remark 9.
	Connections: Plain end butt welded or slip joint fillet welded.
	Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150; ends to match pipe.
	Lining: Cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches.
	Coating: None. (No coating on the encased pipes.)
<u>Remarks:</u>	
<ol style="list-style-type: none"> 1. See Section 01450 for area corrosion classification. 2. Provide protective coatings, joint bonding, electrical isolation, and galvanic anode cathodic protection system as indicated for ferrous metal pipe. 3. Pipes and valves materials in this system shall be lead free EPA SDWA and meet NSF/ANSI Standards 61 or 372. 4. C1 piping installed over suspended ceilings shall be insulated for condensation control in accordance with Section 15260. 5. Piping installed over suspended ceilings shall be insulated for condensation control in accordance with Section 15260. 6. DH, HW, HWR, and TW piping shall be insulated in accordance with Sections 15260 (above ground). 7. Manual air vents shall be provided at the high points and manual drains shall be provided at the low points of each reach of pipeline as specified in this Section and/or indicated in the Drawings. 8. Resilient seal gate valves shall be iron body, bronze mounted, and non-rising stem conforming to AWWA C509. Valves shall be equipped with a 2-inch operating nut and "O" ring stem seals. 9. Where stainless steel is called out on drawings, shall be as per specification Section 15067. 10. Provide a PVC sleeve or polyethylene wrap for all copper piping encased or in contact with concrete. Minimum wall thickness of wrap shall be 0.025 inch. 11. Butt weld connections are not permitted with lined pipe unless coatings and linings can be repaired. 	

3.13 PIPESPEC - PIPING SYSTEM 9

Piping Symbol/Service:	C4 – Landscaping Irrigation
Test Requirements:	
Medium:	Water, as specified in this Section.
Pressure:	125 PSI
Duration:	120 minutes
Allowable leakage:	Zero, as specified in this Section.
Gasket Requirements:	
Flange:	Rubber, nitrile, or Neoprene.
Push-on/Mech Cpl:	N/A.
Exposed Pipe and Valves:	
(See Drawing for pipe size and valve type)	
(3" and smaller)	
Pipe:	Copper tube: ASTM B88, Type L, drawn. Ref. Section 15066. Connections: solder or threaded or flanged adapters for valves, unions at equipment and valves. Fittings: wrought copper or bronze, ASME B16.22. Lining: None. Coating: None.
Valves:	Ball valves: Ref. Section 15104. Gate valves: Ref. Section 15101. Swing Check valves: Ref. Section 15150.
Buried and Encased Pipe and Valves:	
(See Drawing for pipe size and valve type)	
(3" and smaller)	
Pipe:	PVC: ASTM D1784, Class 12454-B, NSF certified, ASTM F441, Sch. 80. Reference Section 15064. Connections: Plain end; solvent cement weld with threaded or flanged adapters for valves. Fittings: PVC, ASTM D2467, Sch. 80, socket type, solvent cement weld. Lining: None. Coating: Reference Section 15064.
Valves:	Gate valves, with extension stem and valve box. Ref. Section 15101.
<u>Remarks:</u>	
<ol style="list-style-type: none"> See Section 01450 for area corrosion classification. Where piping may be exposed to sunlight, pipe and fittings shall be painted in accordance with Section 15064. 	

3.14 PIPESPEC - PIPING SYSTEM 12

Piping Symbol/Service:	RS – Raw Sewage
Test Requirements:	
Medium:	Water, as specified in this Section.
Pressure:	RS (Steel) – 65 PSI RS (HDPE) – 35 PSI RS (FRPP) – 4 PSI
Duration:	120 minutes
Allowable leakage:	Zero, as specified in this Section.
Gasket Requirements:	
Flange:	Steel: Rubber or Neoprene, AWWA C207. FRPP: see Spec Section 15069.
Push-on/Mech Cpl:	Nitrile or Neoprene.
Joint (FRPP):	Ref. Section 15069.
Exposed Pipe and Valves:	
(See Drawing for pipe size and valve type)	
(4" through 24")	
Pipe (Ref. Section 15061):	Steel: ASTM A53 ERW, Grade B, black, Ref. Section 15061. Connections: butt weld, grooved mechanical pipe coupling or flanged. Fittings: malleable iron, ductile iron, or steel; ends to match pipe. Lining: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches. Coating: Ref. Section 15061.
Valves:	Eccentric Plug: Section 15107. Install valve with seat upstream. Swing Check: cushioned, Section 15111.
(96", gravity)	
Pipe(Ref. Section 15069):	FRPP: ASTM D3262, SN 72, PN 25. Connections: Ref. Section 15069. Fittings: Ref. Section 15069. Lining: None. Coating: None.
Buried Pipe and Valves:	
(See Drawing for pipe size and valve type)	
(6")	
Pipe (Ref. Section 15065):	High Density Polyethylene (HDPE): ASTM D3350. Connections: Butt fusion welded with flanged adapters for valves. Fittings: Ends and SDR to match pipe. Lining: None. Coating: None.
(8" through 24")	
Pipe (Ref. Section 15061):	Steel: AWWA C200. Connections: Butt weld, flanged for valves. Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150; ends to match pipe. Lining: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches. Coating: Ref. Section 15061.
Valves:	Eccentric Plug: Same as exposed with extension stem and

Piping Symbol/Service:		RS – Raw Sewage
		valve box. Section 15107.
(96", gravity)		
Pipe (Ref. Section 15069):	FRPP: ASTM D3262, SN 72, PN 25.	
	Connections: Ref. Section 15069.	
	Fittings: Ref. Section 15069.	
	Lining: None.	
	Coating: None.	
Encased Pipe and Flexible Connection for Steel Pipe and Valves:		
(See Drawing for pipe size and valve type. No coating on encased pipe.)		
(6" through 24")		
Pipe (Ref. Section 15061):	Steel: AWWA C200.	
	Connections: Butt weld, flanged for valves.	
	Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150; ends to match pipe.	
	Lining: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches.	
	Coating: Ref. Section 15061.	
Valves:	Eccentric Plug: Same as exposed with extension stem and valve box. Section 15107.	
(96", gravity)		
Pipe (Ref. Section 15069):	FRPP: ASTM D3262, SN 72, PN 25.	
	Connections: Ref. Section 15069.	
	Fittings: Ref. Section 15069.	
	Lining: None.	
	Coating: None.	
Remarks:		
<ol style="list-style-type: none"> 1. See Section 01450 for area corrosion classification. 2. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in Section 15095 and as shown in the Drawings. 3. Grooved or shouldered mechanical pipe couplings are permitted with fabricated pipe if the rated working pressure of the coupling exceeds the specified test pressure. Butt weld connections are not permitted with lined pipe unless coatings and linings can be repaired. 4. Provide protective coatings, joint bonding, electrical isolation, and galvanic anode cathodic protection system as indicated for ferrous metal pipe. 		

3.15 PIPESPEC - PIPING SYSTEM 13

A.

Piping Symbol / Service:	EFF- Effluent EFFR - Effluent Recirculation SN - Supernatant
Test Requirements:	
Test Medium:	Water, as specified in this Section.
Test Pressure:	EFF and EFFR: 15 PSI SN: 20 PSI.
Duration:	120 minutes.
Leakage:	Zero, as specified in this Section.
Gasket Requirements:	
Flanged:	Steel: Rubber or Neoprene, AWWA C207. HDPE: Ref. Section 15065.
Push on/Mechanical coupling:	Nitrile or Neoprene.
Exposed and Submerged Pipe and Valves:	
(See Drawings for pipe size and valve type)	
(Smaller than 12")	
Pipe (Ref. Section 15061):	Steel: ASTM A53 ERW, Grade B, black. Connections: butt weld, grooved mechanical pipe coupling or flanged. Fittings: malleable iron, ductile iron, or steel; ends to match pipe. Lining: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6". Coating: Ref. Section 15061.
Valves:	None
(12" through 72")	
Pipe (except EFFR) (Ref. Section 15061):	Steel: AWWA C200. Connections: Butt weld, grooved mechanical pipe coupling or flanged. Fittings: Malleable iron, ductile iron, or steel; ends to match pipe. Lining: cement mortar. Coating: Ref. Section 15061.
Pipe (EFFR only) (Ref. Section 15065):	High Density Polyethylene (HDPE): ASTM D3350. Connections: Thermal socket fusion or butt fusion welded with flanged adapters for valves. Fittings: Ends and SDR to match pipe. Lining: none. Coating: none.
Valves:	Butterfly: Section 15103 Plug: Section 15107. Flap Gate: Section 15150
Buried Pipe and Valves:	
(See Drawings for pipe size and valve type. See remark for encased pipe.)	
(Smaller than 48")	
Pipe (Ref. Section 15065):	High Density Polyethylene (HDPE): ASTM D3350. Connections: Thermal socket fusion or butt fusion welded with flanged adapters for valves. Fittings: Ends and SDR to match pipe. Lining: none. Coating: none.

Piping Symbol / Service:	EFF– Effluent EFFR – Effluent Recirculation SN – Supernatant
Pipe (optional) (EFFR only) (Ref. Section 15062):	Ductile iron: Class 53, AWWA/ANSI C151/A21.51. Ref. Section 15062. Connections: Push-on restrained joint. Flanged at valves. Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron, or AWWA/ANSI C153/A21.53 ductile iron compact fittings, ends to match pipe. Lining: cement mortar. Coating: Bituminous. Polyethylene encasement, Ref. Section 15062.
(48” through 72”)	
Pipe (except EFF) (Ref. Section 15062):	Ductile iron: Class 53, AWWA/ANSI C151/A21.51. Ref. Section 15062. Connections: Push-on restrained joint. Flanged at valves. Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron, or AWWA/ANSI C153/A21.53 ductile iron compact fittings, ends to match pipe. Lining: cement mortar. Coating: Bituminous. Polyethylene encasement, Ref. Section 15062.
Valves:	Butterfly: Section 15103
Pipe (EFF only) (Ref. Section 15069)	FRPP: ASTM D3517, SN 72, PN 25. Connections: Ref. Section 15069. Fittings: Ref. Section 15069. Lining: None. Coating: None.
Valves:	None.
Encased Pipe and Flexible Connection for Steel Pipe:	
Pipe:	Steel: AWWA C200. Ref. Section 15061. Connections: butt weld. Fittings: AWWA C208. Lining: cement mortar. Coating: None
Valves:	None.
<u>Remarks:</u>	
<ol style="list-style-type: none"> 1. See Section 01450 for area corrosion classification. 2. Provide protective coatings, joint bonding, electrical isolation, and galvanic anode cathodic protection system as indicated for ferrous metal pipe. 3. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in Section 15095. 4. Grooved mechanical pipe couplings, 10 to 24 inch size, may be used with standard weight or heavier pipe. Grooved or shouldered mechanical pipe couplings are permitted with fabricated pipe if the rated working pressure of the coupling exceeds the specified test pressure. 5. Butt weld connections are not permitted with lined pipe unless coatings and linings can be repaired. 	

3.16 PIPESPEC - PIPING SYSTEM 16

Piping Symbol / Service:	PS – Primary Solids SSL – Sand Slurry TBS – Thickened Bottom Sludge
Test Requirements:	
Test Medium:	Water, as specified in this Section
Test Pressure:	150 PSI TBS – 20 PSI
Duration:	120 minutes
Leakage:	Zero, as specified in this Section
Gasket Requirements:	
Flanged:	Steel: Rubber or Neoprene, AWWA C207. HDPE: Ref. Section 15065.
Grooved:	Nitrile or Neoprene.
Exposed and Submerged Pipe and Valves:	
(See Drawings for pipe size and valve type)	
(4" thru 24")	
Pipe (Ref. Section 15061):	Steel: ASTM A53, ERW, Grade B, black, Schedule 40 minimum.. See Remark 7. Connections: Butt weld, grooved mechanical pipe coupling or flanged. See remark 3. Fittings: Malleable iron, ductile iron, or Wrought carbon steel; ends and lining to match pipe. Lining: PS and TBS: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6". SSL: None. Coating: Ref. Section 15061.
Valves:	Eccentric Plug: Per Section 15107. Install valve with seat upstream. Swing Check: Spring loaded per Section 15110.
Buried Pipe and Valves:	
(See Drawings for pipe size and valve type. See remark for encased pipe)	
(4" thru 24")	
Pipe (Ref. Section 15065):	High Density Polyethylene (HDPE): ASTM D3350. Connections: Thermal socket fusion or butt fusion welded with flanged adapters for valves. Fittings: Ends and SDR to match pipe. See Remark 8. Lining: none. Coating: none.
Valves:	Eccentric Plug: Per Section 15107, same as exposed with extension stem and valve box.
Encased Pipe and Flexible Connection for Steel Pipe:	
(See Drawings for pipe size and valve type)	
(4" thru 24")	
Pipe (Ref. Section 15061):	Steel: ASTM A53, ERW, Grade B, black, Schedule 40 minimum. See Remark 7. Connections: Butt weld. Fittings: Wrought carbon steel; wall thickness, ends and lining to match pipe. Lining: PS and TBS: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6". SSL: None.

Coating: None. (No coating on the encased pipes.)

Remarks:

1. See Section 01450 for area corrosion classification.
2. Manual air vents shall be provided at the high points and drains provided at the low points of each reach of pipeline as specified in Section 15095.
3. SSL pipe shall have the factory grooved end and grooved couplings except at the equipment and flow meter connections. Flanges shall be used at the equipment and flow meter connections.
4. Butt weld connections are not permitted with lined pipe unless coatings and linings can be repaired.
5. Provide long radius elbows for TBS pipes.
6. Grooved connections shall be provided for exposed TBS pipes so that each segment shall not exceed 6 feet long or containing more than 2 fittings.
7. Where stainless steel is called out on drawings, shall be as per specification Section 15067.
8. 5-piece fabricated HDPE elbows shall be used for TBS.

3.17 PIPESPEC - PIPING SYSTEM 18

Piping Symbol/Service:	FOR – Fuel Oil Return FOS – Fuel Oil Supply FV – Fuel Vent
Test Requirements:	
Medium:	Preliminary test: Air, Nitrogen, or Inert gas Final test: Lube oil and fuel oil, as specified in this Section.
Pressure:	150 PSI (fuel piping, pressure piping) 5 PSI (secondary containment piping, non-pressure piping)
Duration:	60 minutes
Allowable leakage:	Zero, as specified in this Section.
Gasket Requirements:	
Flange:	Steel: Rubber or Neoprene, AWWA C207.
Push-On/Mcl Cpl:	N/A
Exposed Pipe and Valves:	
(See Drawing for pipe size and valve type)	
(6" and smaller)	
Exposed Pipe and Valves Generator Building and Vent Piping:	
Pipe (Per Section 15061):	Steel: ASTM A106, seamless, Grade B, black, Sch. 40, pickled, oiled and capped. Connections: threaded or socket end with threaded adapters for valves. Fittings: forged steel, ASTM A105, ANSI B16.11, pressure Class 3000, pickled, oiled and capped. Unions: flat faced O-ring type with Buna-N O-ring. Lining: none. Coating: Ref. spec Section 15061.
Valves:	Ball valves, Ref. Section 15104. Swing check valves, Ref. Sections 15150. Thermal link actuated shut off valve: UL listed, for closure at 212 degrees F. Factory Mutual approved, carbon steel body, non-venting for fuel oil service, NPT connections. Cashco, Inc., Essex Industries, Inc., or Approved Equal.
Exposed Pipe and Valves Outdoors:	
(Double Wall contained pipe)	
(1" and smaller)	
Pipe (Per Section 15061):	Steel: ASTM A106, seamless, Grade B, black, Sch. 40, pickled, oiled and capped. Connections: socket weld. Fittings: forged steel, ASTM A105, ANSI B16.11, pressure Class 3000, pickled, oiled and capped. Union: flat faced O-ring type with Buna-N-O-ring. Containment Casing: C.S. pipe per ASTM A139 of A135 by Tricon Piping System, Inc. or Approved Equal. Coating: Ref. Section 15061.
Valves:	Ball Valves: Ref. Section 15104. Swing check valves: Ref. Section 15150.

Piping Symbol/Service:

FOR – Fuel Oil Return
FOS – Fuel Oil Supply
FV – Fuel Vent

Remarks:

1. See Section 01450 for area corrosion classification.
2. The cleaning (pickling) solution used shall comply with Mil-H-13528B. Immediately following pickling and rinsing procedures, steel pipe and fittings shall be coated inside and outside with a rust and corrosion preventative system, and the ends sealed to prevent the entry of dirt.
3. Low pressure air testing of approximately 5 PSI is allowed for testing the secondary containment piping. Test boots shall be installed at both ends of double containment pipe for testing, as indicated in the Drawings.
4. Provide the FV lines with a cast iron downward mushroom vent with a threaded connection and a 40 mesh brass screen that can be easily removed for cleaning.
5. Outdoor exposed piping, except FV piping, shall be insulated, and aluminum jacketed per Spec Section 15260.
6. Install flat-faced O-ring type unions or flanges immediately downstream or upstream of the equipment and valves.
7. Anti-Siphon valves shall be installed at high point of the fuel supply pipe. Anti-Siphon valve shall be adjustable and adjusted and set according to the system's working pressure to provide seal tight shut off when the system pressure is off.

3.18 PIPESPEC - PIPING SYSTEM 19

Piping Symbol / Service:	COAG – Coagulant DF – Defoamer MO – Mineral Oil NaOH – Sodium Hydroxide OF – Overflow POL - Polymer
Test Requirements:	
Test Medium:	Water, as specified in this Section
Test Pressure:	150 PSI
Duration:	120 minutes
Leakage:	Zero, as specified in this Section
Gasket Requirements:	
Flanged:	TFE bonded EPDM, full-face gaskets, Garlock Gylon 3504, or Approved Equal.
Push on/Mechanical coupling:	N/A
Exposed Pipe and Valves:	
(See Drawings for pipe size and valve type)	
(4" and smaller)	
Pipe (Ref. Section 15064):	CPVC: ASTM D1784, Class 12454-B, NSF certified, ASTM D1785, Sch.80. Pipe and fittings exposed to sunlight shall be painted. Connections: Plain end, solvent cement weld, flanged for valves 3 inches and larger. Fittings: CPVC, Sch. 80, solvent cement weld. Lining: none. Coating: Ref. Section 15064.
(4" and smaller)	
Valves:	Ball valves, Ref. Section 15104. Diaphragm valves, Ref. Section 15150. See Remarks. Ball Check valves, Ref. Section 15150. See Remarks.
Buried and Encased Pipe and Valves:	
(See Drawings for pipe size and valve type. No coatings on encased pipe)	
(4" and smaller)	
Pipe (Ref. Section 15064):	CPVC: Same as exposed. Connections: Same as exposed. Fittings: Same as exposed. Lining: none. Coating: Ref. Section 15064.
(4" and smaller)	
Valves:	Ball: same as exposed with extension stem and valve box. Diaphragm: same as exposed with extension stem and valve box.
<u>Remarks:</u> 1. See Section 01450 for area corrosion classification. 2. Pipe support spacing for service piping in this system shall not exceed 60 percent of the maximum spacing specified for plastic piping. 3. Material of Valve shall match pipe material. 4. Teflon seats, seals, and diaphragm for all services in this system.	

3.19 PIPESPEC - PIPING SYSTEM 21

Piping Symbol/Service:	SAM -- Sample
Test Requirements:	
Medium:	Water; as specified in this Section.
Pressure:	150 PSI
Duration:	120 minutes
Leakage:	Zero, as specified in this Section.
Gasket Requirements:	
Flange:	Rubber or Neoprene
Indoor Exposed, buried and submerged Pipe and Valves:	
(See Drawing for pipe size and valve type)	
(All sizes)	
Pipe (Ref. Section 15064):	PVC Pressure Pipe: Schedule 80. Connections: solvent weld with chemical resistant primer/solvent. Fittings: Solvent welded socket type complying with ASTM D2466. Lining: none. Coating: Ref. Section 15064.
Valves:	Ball valves, Ref. Section 15104.
<u>Remarks:</u>	
1. See Section 01450 for area corrosion classification.	

3.20 PIPESPEC - PIPING SYSTEM 22

Piping Symbol/Service:	FA -- Foul Air SPA – Supply Air TA – Treated Air
Test Requirements:	
Medium:	Air; as specified in this Section.
Pressure:	15 psig for FA piping 10” and smaller 20” water column for 12” and larger ductwork.
Duration:	60 minutes.
Gasket Requirements:	
Flange:	Gylon gasketing, Garlock Style 3504, or Approved Equal.
Push-on/Mech Cpl	TFE.
Exposed Pipe, Duct, and Dampers:	
(See Drawing for pipe size and valve type)	
(All sizes)	
Pipe (except air sample pipes) or Duct:	FRP: Fiberglass Reinforced Plastic. Ref. Spec Section 13234. Lining: Ref. Section 13234. Coating: Ref. Section 13234.
Dampers:	Butterfly: FRP, Ref. Section 13234.
Buried and Encased Pipe and Valves:	
(All sizes)	
Pipe and Duct:	FRP: Fiberglass Reinforced Plastic. Ref. Spec Section 13234. Lining: Ref. Section 13234. Coating: Ref. Section 13234.
Remarks:	
<ol style="list-style-type: none"> See Section 01450 for area corrosion classification. Expansion joints and flexible connectors shall be installed where indicated in the Drawings. Expansion joints and flexible connectors for foul air ductwork shall be as specified in Section 13234. Connections from other materials to FRP shall be made by flanged transitions, unless otherwise specified or indicated in the Drawings. All sizes of exposed circular and rectangular foul air ductworks shall be FRP as specified in spec Section 13234. Provide continuous slope for ductwork toward the nearest low point drain. Duct shall not be routed in such a way as to create low points that will collect condensate. Minimum slope of 0.2%. Slope buried ductwork as shown in the Drawings. 	

3.21 PIPESPEC - PIPING SYSTEM 24

Piping Symbol/Service:	CDD – Condensate Drain D – Drain RD – Roof Drain V – Vent
Test Requirements:	
Medium:	In accordance with Uniform Plumbing Code.
Pressure:	In accordance with Uniform Plumbing Code.
Duration:	In accordance with Uniform Plumbing Code.
Gasket Requirements:	
Flange:	Rubber or Neoprene, AWWA C207 (steel) or AWWA C111 (ductile iron). HDPE: Ref. Section 15065.
Push-on/Mech Cpl:	Nitrile or neoprene.
Exposed Pipe and Valves:	
(See Drawing for pipe size and valve type)	
<u>(2 1/2" and smaller)</u>	
Pipe (Ref. Section 15064):	PVC Pressure Pipe: Schedule 40. Connections: solvent weld; for drains serving odor control ducts/equipment use solvent weld with chemical resistant primer/solvent. Fittings: Solvent welded socket type complying with ASTM D2665.
Valves:	Ball valves, Ref. Section 15104.
<u>(3" thru 12")</u>	
Pipe (except cistern system) (Ref. Section 15073):	Acid-Resistant Cast iron soil pipe (CISP): ASTM A74 or ASTM A888, CISPI 301. Connections: service hub and spigot compression type per ASTM A74 or hubless cast iron sanitary system per CISPI 310. Fittings: CISP, ASTM A74 or CISPI 301, joint options to match pipe.
Pipe (cistern system only) (Ref. Section 15061):	Steel: ASTM A53, ERW, Grade B, black, Schedule 40 minimum. Connections: Butt weld, grooved mechanical pipe coupling or flanged. Fittings: Malleable iron, ductile iron, or segmented welded steel; ends and lining to match pipe. Lining: cement mortar. Coating: Ref. Section 15061.
Valves:	Ball valves, Ref. Section 15104.
<u>(14" and larger)</u>	
Pipe (Ref. Section 15062):	Ductile iron: AWWA C151. See Remarks. Connections: flanged or mechanical joint. Fittings: ductile iron; ends to match pipe.
Valves:	None
Buried and Encased Pipe and Valves:	
(See Drawing for pipe size and valve type)	
<u>(2 1/2" and smaller)</u>	
Pipe:	PVC: same as exposed.
Valves:	None.

Piping Symbol/Service:	CDD – Condensate Drain D – Drain RD – Roof Drain V – Vent
(3" thru 12")	
Pipe (except cistern system) (Ref. Section 15073):	Acid-resistant Cast iron soil pipe (CISP): same as exposed.
Pipe (cistern system only) (Ref. Section 15065):	High Density Polyethylene (HDPE): ASTM D3350. See Remarks.
	Connections: Thermal socket fusion or butt fusion welded with flanged adapters for valves.
	Fittings: Ends and SDR to match pipe.
Valves:	Lining: none.
	Eccentric Plug: Ref. Section 15107.
<u>Remarks:</u> 1. See Section 01450 for area corrosion classification. 2. Backwater valves, where specified, shall be as follows: a. Vertical: Josam 1000 Series, Smith Fig. 7080, or Approved Equal. b. Horizontal: Josam 1100-41 Series, Smith Fig. 7012, or Approved Equal. 3. HVAC equipment condensate drains shall be copper tube; ASTM B88, Type M, drawn. Fittings shall be wrought copper or bronze, ASME B16.22. Connections shall be solder type with threaded adapters for equipment connections where required. Products and fabrication shall be as specified in Section 15066. 4. For odor control system, connections from PVC to FRP pipe shall be per the FRP manufacturer's recommendations and as indicated in the Drawings. 5. Provide joint bonding, electrical isolation, and galvanic anode cathodic protection system as indicated for buried ferrous metal pipe. 6. Provide sanitary wye fittings to connect each drain to drainage trunks/headers. 7. Vent pipes, 12" through 24", which are located outside the structure, shall be as follows: a. Stainless steel: ASTM A778, Type 304L, Schedule 10. Ref. Section 15067. b. Connection: Butt weld or flanged, couplings where specified. c. Fittings: ASTM A774, material, ends, and wall thickness to match pipe. 8. Butt weld connections are not permitted with lined pipe unless coatings and linings can be repaired.	

3.22 PIPESPEC - PIPING SYSTEM 24A

Piping Symbol / Service:	DR – Process Drain
Test Requirements:	
Test Medium:	Water.
Test Pressure:	15 PSI.
Duration:	120 minutes.
Gasket Requirements:	
Flanged:	Rubber or Neoprene
Push on:	Neoprene, ASTM F477
Exposed Pipe and Valves:	
(See Drawings for pipe size and valve type)	
(12" and smaller)	
Pipe (Ref. Section 15064):	PVC Pressure Pipe: Schedule 40. Connections: solvent weld with chemical resistant primer/solvent. Fittings: Solvent welded socket type complying with ASTM D2466.
(3 1/2" and smaller)	
Valves:	Ball valves, Ref. Section 15104.
(4" through 12")	
Valves:	Plug valves, Ref. Section 15107. Flap Gate: Ref. Section 15150
Buried and Encased Pipe and Valves:	
(See Drawings for pipe size and valve type.)	
(3 1/2" and smaller)	
Pipe (Ref. Section 15064):	PVC Pressure Pipe: Schedule 80.
Valves:	None.
(4" through 12")	
Pipe (Ref. Section 15064):	PVC: ASTM D3034, SDR 35. Connections: elastomeric-gasket type with a pressure rating not less than pipe pressure rating, ASTM D3139. Fittings: elastomeric-gasket type with a pressure rating not less than pipe pressure rating, ASTM D3139.
Valves:	None
<u>Remarks:</u>	
1. See Section 01450 for area corrosion classification.	

3.23 PIPESPEC - PIPING SYSTEM 24B

Piping Symbol/Service:	PDR – Process Basin Drain
Test Requirements:	
Medium:	Water, as specified in this Section.
Pressure:	15 PSI
Duration:	120 minutes
Gasket Requirements:	
Flange:	Steel: Rubber or Neoprene, AWWA C207.
Exposed Pipe and Valves:	
(See Drawing for pipe size and valve type)	
Pipe (Ref. Section 15061):	Steel: ASTM A53 ERW, Grade B, black. Connections: butt weld or flanged. Fittings: steel; ends to match pipe. Lining: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches. Coating: Ref. Section 15061.
Valves:	Eccentric Plug: Section 15107. Install valve with seat upstream. Flap Gate: Section 15150
Buried and Encased Pipe and Valves:	
(See Drawing for pipe size and valve type)	
Pipe (Ref. Section 15061):	Steel: ASTM A53, ERW, Grade B, black. Connections: Butt weld. Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150; ends to match pipe. Lining: cement mortar for pipes 6" and larger; epoxy for pipes smaller than 6 inches. Coating: Ref. Section 15061. No coating for encased.
Valves:	None.
<u>Remarks:</u>	
<ol style="list-style-type: none"> See Section 01450 for area corrosion classification. Butt weld connections are not permitted with lined pipe unless coatings and linings can be repaired. 	

3.24 PIPESPEC - PIPING SYSTEM 25

Piping Symbol / Service:	CD – Chemical Drain VC – Chemical Vent
Test Requirements:	
Test Medium:	Water.
Test Pressure:	15 PSI. See remarks.
Duration:	120 minutes.
Gasket Requirements:	
Flanged:	N/A
Push on/Mechanical coupling:	N/A
Exposed Pipe and Valves:	
(See Drawings for pipe size and valve type)	
(All sizes)	
Pipe (Ref. Section 15064):	CPVC: ASTM D1784, Class 12454-B, ASTM F441, Sch. 80. Connections: Plain end; solvent weld with chemical resistant primer/solvent. Threaded or flanged adapters for valves. Fittings: CPVC, ASTM D2467, Sch. 40, socket type, solvent cement weld. Lining: None. Coating: Ref. Section 15064.
Valves:	Ball valves, Ref. Section 15104. Flap Gate: Ref. Section 15150
Buried and Encased Pipe and Valves:	
(See Drawings for pipe size and valve type.)	
(All sizes)	
Pipe (Ref. Section 15064):	CPVC: Same as exposed. Connections: Plain end; solvent weld with chemical resistant primer/solvent. Fittings: Same as exposed. Lining: None. Coating: None.
Valves:	Mud valves, Ref. Section 15150
Remarks:	
<ol style="list-style-type: none"> 1. See Section 01450 for area corrosion classification. 2. Material of Valve shall match pipe material. 3. Buried and above grade expansion joints/flexible couplings where indicated, see Section 15064. 4. Testing pressure for drains in the odor control system shall be 1 psi. 	

3.25 PIPESPEC - PIPING SYSTEM 28

Piping Symbol/Service:	SS – Sanitary Sewer
Test Requirements:	
Medium:	In accordance with WSDOT 7-17.3(2) or City of Seattle Standards as applicable
Pressure:	In accordance with WSDOT 7-17.3(2) or City of Seattle Standards as applicable
Duration:	In accordance with WSDOT 7-17.3(2) or City of Seattle Standards as applicable
Gasket Requirements:	
Push-on/Mech Cpl:	N/A
Buried and Encased Pipe and Valves:	
(See Drawing for pipe size and valve type)	
(4" thru 24")	
Pipe (Ref. Section 15064):	PVC: ASTM D3034 and ASTM F679, SDR 35.
	Connections: solvent cement weld.
	Fittings: solvent cement weld.
	Lining: none.
	Coating: none.
Valves:	None

3.26 PIPESPEC - PIPING SYSTEM 31

Piping Symbol / Service:	EE – Engine Exhaust
Test Requirements:	
	No visible or detectable fumes inside structures.
Test Medium:	None
Test Pressure:	None
Duration:	None
Gasket Requirements:	
Flanged:	See Remarks.
Push on/Mechanical coupling:	N/A
Exposed Pipe and Valves:	
(See Drawings for pipe size and valve type)	
(All sizes)	
Pipe(Ref. Section 15067):	Stainless Steel: ASTM A312, Type 321 or 316L seamless, Schedule 10S, welded. Connections: Butt weld, flanged for equipment connections. Fittings: ASTM A403, material, thickness, and end connections to match pipe.
<u>Remarks:</u>	
<ol style="list-style-type: none"> 1. See Section 01450 for area corrosion classification. 2. Pipe, fittings, and engine silencer shall be insulated with high temperature removable, flexible blanket type insulation per Section 15260. Insulation at silencer access ports shall be designed for easy and more frequent removal. 3. Flange gasket shall be flat, full-face, graphoil suitable for temperatures to 1200 degrees F. 4. Welding shall be done in accordance with Section 15067. 5. Expansion joints shall be provided where shown in the Drawings in accordance with Section 15090. 	

3.27 PIPESPEC - PIPING SYSTEM 33

Piping Symbol / Service:	FP – Fire Protection (Site)
Test Requirements:	
Medium:	Water, as specified in this Section.
Pressure:	150 PSI
Duration:	120 minutes
Leakage:	Zero, as specified in this Section
Gasket Requirements:	
Flange:	Ductile Iron: Rubber or Neoprene, AWWA C111
Push-On/Mech Cpl:	Nitrile or neoprene
Exposed Pipes and Valves:	
(See Drawings for pipe size and valve type)	
(3" through 8")	
Pipe (Ref. Section 15062):	Ductile Iron: AWWA C151. Connections: Grooved end mechanical joints. Flanges for valves and penetrations. Fittings: Ductile iron; lining and ends to match pipe. See remarks for additional FP pipe requirements. Lining: cement mortar. Coating: Ref. Section 15062.
Valves:	Gate valves, Ref. Section 15101. Valves and fittings shall be UL listed for fire protection and installed in accordance with NFPA 13.
Buried and Encased Pipe and Valves:	
(See Drawing for pipe size and valve type)	
(3" through 8")	
Pipes (Ref. Section 15062):	Ductile Iron: AWWA C151. Connections: Grooved end or restrained push-on rubber gasket joint. Flange adapters for valves. Fittings: Ductile iron; lining and ends to match pipe. Lining: cement mortar. Coating: Bituminous. Polyethylene encasement.
Valves:	Gate valves, same as exposed with extension stem and valve box. Ref. Section 15101. Valves and fittings shall be UL listed for fire protection and installed in accordance with NFPA 13.
<u>Remarks:</u>	
<ol style="list-style-type: none"> 1. See Section 01450 for area corrosion classification. 2. Resilient seat gate valves shall be iron body, bronze mounted, and non-rising stem conforming to AWWA C509. Valves shall be equipped with a 2-inch operating nut and O-ring stem seals. 3. Provide protective coatings, electrical isolation, and joint bonding as indicated for buried ferrous metallic pipe. 4. Fire hydrants, valves, and other pipeline appurtenances shall conform to the standards of the City of Seattle. 5. Fire protection (FP) service pipe within facilities is specified in Section 15330. Fire protection (FP) service pipe shall be UL listed for fire. 	

END OF SECTION

SECTION 15061

STEEL PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies steel pipe and fittings.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASME B16.3	Malleable Iron Threaded Fittings, Class 150 and 300
ASME B16.11	Forged Steel Fittings, Socket-Welding and Threaded
ASME Section IX	Boiler and Pressure Vessel Code; Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators
ASTM A47	Ferritic Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A105	Forgings, Carbon Steel, for Piping Components
ASTM A106	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A516	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A1018	Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
AWS D1.1	Structural Welding Code - Steel
AWS A2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination
AWS A3.0	Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying
AWS QC1	Standard for Certification of Welding Inspectors
AWWA C200	Steel Water Pipe 6 In. (150 mm) and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe--4 In. and Larger-- Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C210	Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipe
AWWA C214	Tape Coating Systems for the Exterior of Steel Water Pipelines
AWWA C604	Installation of Buried Steel Water Pipe – 4 In. (100 mm) and Larger
AWWA M11	Steel Pipe--A Guide for Design and Installation
SSPC-SP10	Near-White Blast Cleaning

- B. Pipe and Fittings Manufacturer:

1. Experienced in fabricating pipe of similar diameters, lengths, and wall thickness required for the Work.

2. Steel Pipe Fabricators Association (SPFA), Lloyd's Registry Certification, or ISO 9001:2000 Certification.
 3. Demonstrate current production capability for volume of work required for Project.
 4. Experience shall include successful fabrication to AWWA C200 standards of at least 200 linear feet of 4-inch diameter or larger pipe, with wall thickness of 3/8 inches or greater, within past 5-year period.
- C. Experience shall be applicable to fabrication plant facilities and personnel, not company or corporation that currently owns fabrication facility or employs personnel.
- D. Welding:
1. Conform to AWWA C200, AWWA C206 and AWS D1.1, as applicable.
 2. Written Welding procedures:
 - a. Shop welding: Qualified by testing in accordance with ASME Section IX.
 - b. Field welding: Qualified by testing in accordance with AWS D1.1.
 3. Welders shall be qualified by the Contractor or Fabricator in accordance with ASME Section IX or AWS D1.1.
 4. Contractor Shop and Field Inspector: In accordance with AWWA C200, AWWA C206 and holding current AWS QC1 CWI certification.
 5. NDT Quality Control Personnel: In accordance with requirements of ASNT SNT-TC-1A, NDT Level II.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data, catalog cuts, or shop drawings describing construction, dimensions, and materials. Indicate on the submittal each Piping System where the product will be used.
- C. Mill test reports, certificates and affidavits of compliance with AWWA C200, ASTM A53, and ASTM A106, as applicable.
- D. Contractor's layout drawings as specified in Section 15050.
- E. Drawings showing cross-section of the pipe wall and joints for each size, pressure rating, and loading and drawings showing details, dimensions, and piece numbers of all fabricated fittings.
- F. Calculations for fabricated fittings that indicate the adequacy of any required reinforcement. Calculations shall be in accordance with the procedures presented in AWWA M11.
- G. Submit calculations and Drawings for proposed alternative thrust restraint or pipe anchorage.
- H. Welding Data: Welding procedures, welder performance qualification test records and Welder Log, welding inspector and nondestructive testing personnel certifications, nondestructive testing procedures.

1.04 TESTING

- A. Factory testing shall conform to the requirements of ASTM A53, ASTM A106, and AWWA C200 as applicable.
- B. Shop Nondestructive Testing:
 1. Welds: 100 percent visually examined by Contractor's Shop Inspector to criteria in ASME BPVC SEC VIII, Division 1.

2. Complete Joint Penetration Groove Welds:
 - a. Spot radiographically examine pipe in accordance with ASME BPVC SEC VIII, Div. 1, Paragraph UW-52.
 - b. Welds that, in opinion of Engineer, cannot readily be radiographed, shall be 100% ultrasonically examined in accordance with paragraph UW-53.
 - c. Groove welds at tee joints shall be 100% ultrasonically examined.
 3. Fillet Welds: 100 percent examine using magnetic particle inspection method in accordance with ASME BPVC SEC VIII, Division 1, Appendix 6.
 4. Air test collars and wrappers in accordance with AWWA C206.
- C. The Engineer reserves the right to witness the factory testing. Inform the Project Representative and the Engineer at least 30 days prior to the factory tests.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Provide steel pipe and fittings in accordance with ASTM A53, ASTM A106, and AWWA C200 as specified in Section 15050, Piping Systems.
- B. Pipe 12-inches and smaller:
 - a. ASTM A53 Grade B, Type E or S or ASTM A106, Grade B.
 - b. Minimum wall thickness: Schedule 40.
- C. Pipe 16-inches through 48-inches:
 - a. ASTM A53 Grade B, Type E or S or ASTM A106, Grade B.
 - b. Minimum wall thickness: 1/4 inch.
- D. Pipe larger than 48-inches:
 - a. Fabricate from ASTM A516, Grade 70 or ASTM A1018 SS, Grade 36.
 - b. Minimum wall thickness: 3/8 inch.
- E. Increase pipe wall thickness where shown or specified, or if required by calculations.

2.02 CONNECTIONS AND JOINTS

- A. As specified in Section 15050 and in conformance with Section 15085.
- B. Coating for buried connections: As specified in Section 15085.
- C. Shop Welded:
 1. Fabricate in accordance with AWWA C200 as modified herein.
 2. Complete joint penetration (CJP) butt joints shall be used for longitudinal, girth, and spiral welds, unless otherwise indicated.
 3. Lengths of pipe shall not be shop-joined using lap joints.
- D. Preparation of Joints for Field Welding:
 1. Butt Joint Welded:
 - a. Plain ends beveled as required by AWWA C200 and Contractor's field Welding Procedures.
 - b. Provide protection for factory beveled pipe ends so ends are not damaged during transport.
 2. Lap Joint Welded:
 - a. Double fillet lap joints in preparation for field welding shall be in accordance with AWWA C200.

- b. For pipe 30 inches in diameter and larger, provide one of the following:
 - 1) Tack weld four metal tabs at equal intervals around inside circumference of bell ends to indicate location at which spigot end has reached maximum penetration into bell. Remove stops after welding of joint.
 - 2) Paint a 3/4-inch wide white stripe on outside circumference of spigot end of pipe. Side of stripe furthest from pipe end shall indicate location at which spigot end has reached maximum penetration into bell. Side of stripe closest to end of pipe will indicate limit of maximum joint pull.
- c. Double welded lap joints and butt-strap joints shall be tapped and drilled for testing in accordance with AWWA C206.

2.03 FITTINGS AND APPURTENANCES

- A. Malleable Iron Threaded Fittings and Appurtenances: In conformance with the requirements of ASTM A47 or ASTM A197, ASME B16.3.
- B. Steel Fittings and Appurtenances:
 - 1. Unless otherwise specified, in conformance with the requirements of ASTM A234, ASTM A105, or ASME B16.11.
 - 2. Wrought carbon steel butt- welding, ASTM A234/A234M, Grade WPB meeting the requirements of ASME B16.9.
 - 3. Fabricated steel fittings and appurtenances: Conform with AWWA C208.
- C. Fittings for Grooved-End Piping Systems:
 - 1. Full flow cast fittings, steel fittings, or segmentally welded fittings with grooves or shoulders designed to accept grooved end couplings.
 - 2. Cast fittings: Cast of ductile iron conforming to ASTM A536 or malleable iron conforming to ASTM A47.
 - 3. Standard steel fittings, including large size elbows: Forged steel conforming to ASTM A106.
 - 4. Standard segmentally welded fittings: Fabricated of Schedule 40 carbon steel pipe.
- D. Unless otherwise specified, all fittings shall be rated for pressure and loadings equal to the pipe.
- E. Pipes cut for groove coupling shall be as specified in the Section 15085.

2.04 PIPE LINING

- A. Epoxy:
 - 1. Unless otherwise specified, pipe and fittings shall be lined with a liquid epoxy as specified in AWWA C210 with the following exceptions:
 - a. No coal tar products shall be incorporated in the liquid epoxy.
 - b. The curing agent may be an amidoamine as well as the other curing agents listed in AWWA C210.
 - 2. The lining shall be applied to a minimum thickness of 16 mils in not less than two coats.
- B. Cement Mortar:
 - 1. Where specified, pipe and fittings shall be lined with cement mortar as specified in AWWA C205.
 - 2. Fittings and specials larger than 24 inches, not fabricated from centrifugally lined straight sections, shall require 2-inch by 4-inch by 13-gage self-furring wire mesh reinforcement for hand-applied lining.
- C. High Temperature Service Epoxy:
 - 1. Where specified, steel pipe and fittings shall be epoxy lined with not less than 10 mils of epoxy suitable for temperatures of 225 degrees F.
 - 2. Surfaces shall be prepared in accordance with SSPC-SP 10 Near White Blast Cleaning, and the lining applied as recommended by the manufacturer.

3. Acceptable Manufacturer:
 - a. 3M, Scotchkote 306.
 - b. Porter, MCR 65 High Solids Epoxy.
 - c. Approved Equal.

D. Glass Lining:

1. Where specified, pipe and fittings shall be glass lined with a dual layer coating system of vitreous material to a minimum thickness of 10 mils.
2. Glass lining shall provide continuous coverage as tested by a low voltage holiday detector with only isolated voids permitted due to casting anomalies. Voids, other than isolated pinholes, shall be cause for rejection.
3. Pipe and fittings shall have all internal welds ground smooth and any voids or slag holes ground out, re-welded and ground smooth.
4. Acceptable Manufacturer:
 - a. Ferroch, MEH-32.
 - b. Vitco, SG-14.
 - c. Approved Equal.

2.05 PIPE COATING

- A. Exposed: As specified in Section 09900 Coating System B-1 or C-1 depending on exposure condition.
- B. Submerged: As specified in Section 09900 Coating System A-1.
- C. Buried:
 1. Epoxy:
 - a. Unless otherwise specified, pipe and fittings shall be coated with a liquid epoxy as specified in AWWA C210 with the following exceptions:
 - 1) No coal tar products shall be incorporated in the liquid epoxy.
 - 2) The curing agent may be an amidoamine as well as the other curing agents listed in AWWA C210.
 - b. The coating shall be applied to a minimum thickness of 16 mils in not less than two coats.
 2. Polyethylene Tape:
 - a. Where specified, pipe and fittings shall be coated and wrapped with prefabricated multilayer cold applied polyethylene tape coating in accordance with AWWA C214.
 - b. The coating application shall be a continuous step operation in conformance with AWWA C214, Section 3.
 - c. The total coating thickness shall be not less than 50 mils for pipe 24 inches and smaller and not less than 80 mils for pipe 26 inches and larger.

2.06 FUSION EPOXY COATING AND LINING

- A. Where specified, steel pipe and fittings shall be fusion epoxy coated and lined.
 1. Application Method: Fluidized bed method, attaining 12 mils minimum dry film thickness.
 2. Surface Preparation: in accordance with SSPC-SP 10 Near White Blast Cleaning.
 3. Acceptable Manufacturer:
 - a. 3M Scotchkote 206N.
 - b. Axatta Nap-Gard 7-2500.
 - c. Approved Equal.

- B. Field welds, connections and otherwise damaged areas shall be coated and patched according to the manufacturer's instructions with a 2-part epoxy compound from the same manufacturer as the coating.
 - 1. Acceptable Manufacturer and products:
 - a. 3M Scotchkote 306
 - b. Axatta Nap-Gard 7-185A
 - c. Approved Equal.

2.07 JOINT GASKETS

- A. Joint gaskets shall be as specified in Section 15075 and Section 15085.

2.08 CORROSION PROTECTION

- A. Where called for in Section 15050 or in the Drawings, buried steel pipe shall be electrically isolated from existing buried steel pipes and from exposed pipe upon penetration through structural walls by installing an insulating union, insulating flange kit or insulating flexible sleeve type coupling, depending on the respective pipe size. Unless otherwise specified, the electrical isolation fittings shall be installed on the exposed pipe as close to the wall penetrations as possible and prior to touching any pipe support or other pipes. The isolated pipe shall not touch reinforcing steel or wall sleeves at the pipe penetration. Restraint harness assemblies or sleeve couplings shall also be equipped with insulating bushings and washers for electrical isolation.
- B. Provide galvanic anode cathodic protection system in accordance with Section 13110.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. Install pipe in accordance with AWWA C604. Weld joints in accordance with AWWA C206 and Section 15085. Tie rods shall be used where indicated and if required for thrust restraint.
 - 2. Provide sleeve-type mechanical pipe couplings in accordance with AWWA M11 and Section 15085.
 - 3. Apply pipe lining and coatings at field joints as specified in this Section.
 - 4. Unless otherwise specified, field coat buried mechanical couplings and valves as specified in Section 15085.
- B. Anchorage:
 - 1. All couplings and fittings shall be restrained joint for thrust restraint.
 - 2. Provide concrete thrust blocks only where indicated in the Drawings.
 - 3. Submit calculations and Drawings for proposed alternative thrust restraint or pipe anchorage.

3.02 FIELD QUALITY CONTROL

- A. Field Welding:
 - 1. All welds, 100 percent visual inspection by Contractor's Field CWI and marked to indicate acceptance or rejection.
 - 2. Test butt-strap or double-welded lap joint welds by pressurizing connection between the two fillet welds in accordance with AWWA C206.
 - a. Apply air or other approved gas into connection between the two fillet welds.
 - b. Paint welds with soap solution.
 - c. Mark leaks indicated by escaping gas bubbles.
 - d. Close threaded openings with flush pipe plugs or by welding them.

3. Complete Joint Penetration Groove Welds:
 - a. Inspect CJP butt welds made from one side without backing with RT at inspection frequency specified in AWS D1.1, Clause 9, Paragraph 9.26. Inspect all other butt welds without backing with 10% RT.
 - b. Inspect 10 percent of all other CJP groove welds with UT.
4. Inspect 10 percent of lap joint welds with PT or MT.
5. Weld Acceptance:
 - a. If, in the opinion of the Engineer, inspections indicate inadequate quality of welds, the percentage of welds inspected will be increased.
 - b. Welds to be inspected, if less than 100 percent rate, shall be selected at random by the Engineer.
 - c. Visual Inspection: AWS D1.1 Table 9.16, Visual Inspection Acceptance Criteria, Tubular Connections.
 - d. RT: AWS D1.1, Paragraphs 9.28 and 9.29.
 - e. UT: AWS D1.1, Paragraph 9.27.
 - f. PT or MT:
 - 1) Perform on fillet and PJP groove welds in accordance with AWS D1.1, Paragraph 6.10.
 - 2) Acceptance shall be in accordance with VT standards specified above.
6. Weld Repair:
 - a. Remove in manner that permits proper and complete repair by welding.
 - b. Caulking or peening of defective welds is not permitted.
 - c. Retest unsatisfactory welds using the same NDT methods.

3.03 TESTING

- A. Hydrostatic testing shall be in accordance with AWWA C604 except that test pressures and allowable leakage shall be as listed in Section 15050.

END OF SECTION

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SECTION 15062

DUCTILE IRON PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies ductile iron pipe, ductile fittings and gaskets.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ANSI A21.14	Ductile-Iron Fittings 3 In. Through 24 In., for Gas
ANSI A21.52	Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand Lined Molds for Gas
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings
ASTM A716	Ductile-Iron Culvert Pipe
ASTM C150	Portland Cement
AWWA C104/(ANSI A21.4)	Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water
AWWA C110/(ANSI A21.10)	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids
AWWA C111/(ANSI A21.11)	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115(ANSI A21.15)	Flanged Ductile-Iron and Gray-Iron Pipe With Threaded Flanges
AWWA C150(ANSI A21.50)	Thickness Design of Ductile-Iron Pipe
AWWA C151(ANSI A21.51)	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C153(ANSI A21.53)	Ductile-Iron Compact Fittings, 3 In. Through 12 In. for Water and Other Liquids
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Type Joints

- B. Certifications specified in the following documents:

1. ANSI A21.14, paragraph 14-4.2.
2. ANSI A21.52, paragraph 52-4.2.
3. ASTM A716, paragraph 4.2.
4. AWWA C110, paragraph 10-5.3.
5. AWWA C111, paragraph 11-7.1.
6. AWWA C115, paragraph 15-4.2.
7. AWWA C151, paragraph 51-5.2.
8. AWWA C153, paragraph 53-6.3.
9. AWWA C606, paragraph 4.1.1.1.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data, catalog cuts, or shop drawings describing construction, dimensions, and materials. Indicate on the submittal each Piping System where the product will be used.
- C. Contractor's layout drawings as specified in Section 15050.
- D. Certifications.
- E. Submit calculations and Drawings for proposed alternative thrust restraint or pipe anchorage.

PART 2 PRODUCTS

2.01 GENERAL

A. Pipe design, materials and manufacture shall comply with the following documents:

Item	Document
Thickness design	AWWA C150
Manufacturing requirements	
Water or other liquid	AWWA C151
Gas	ANSI A21.52
Gravity service pipe	ASTM A716
Joints	
Rubber gasket	AWWA C111
Threaded flange	AWWA C115
Fittings	
Water or other liquid	AWWA C110/AWWA C153
Gas	ANSI A21.14
Cement mortar lining	AWWA C104

2.02 PIPE

- A. Unless otherwise specified, ductile iron pipe shall be Class 52 pipe having nominal laying lengths of 18 or 20 feet.
- B. For grooved-end pipe, special thickness class shall be minimum Class 53 except where the specified pressure requires heavier pipe.

2.03 GASKETS

- A. Unless otherwise specified, gasket stock shall be a synthetic rubber compound in which the elastomer is nitrile or neoprene. The compound shall contain not less than 50 percent by volume nitrile or neoprene and shall be free from factice, reclaimed rubber and other deleterious substances.
- B. Gaskets shall comply with AWWA C111 for push-on and mechanical joints and with AWWA C606 for grooved end joints.

2.04 FITTINGS

- A. Unless otherwise specified, fittings shall conform to AWWA C110.
- B. All fittings shall be rated for a minimum working pressure of 250 psi.

- C. Ends: Flanged, restrained mechanical joint, restrained push-on, or grooved to suit the conditions specified.
- D. Unless otherwise specified, the AWWA C153 compact ductile iron fittings in sizes 3 through 12 inches are an acceptable substitute for standard fittings.
- E. Provide long-radius elbows where specified.
- F. Grooved End Fittings: In compliance with AWWA C606.

2.05 JOINTS

- A. Unrestrained Joints:
 - 1. Push-On Joints:
 - a. Where specified shall be the rubber ring compression, push-on type joint suitable for buried service.
 - b. Unless otherwise indicated, joints shall have an allowable deflection of up to 5 degrees at specified pressures.
 - c. Unless otherwise indicated, this joint is not permitted on fittings or specials.
 - d. Joint assembly and field cut joints shall be made in strict conformance with AWWA C600 and manufacturer's recommendations.
 - e. Acceptable manufacturer:
 - 1) American Cast Iron Pipe Company, Fastite Joint.
 - 2) U.S. Pipe, Tyton Joint.
 - 3) Approved Equal.
 - 2. Mechanical Joints:
 - a. Where specified, mechanical joints for above or below ground service shall meet the requirements of ANSI/AWWA A21.10/C110 and ANSI/AWWA A21.11/C111.
 - b. Gaskets and bolts and nuts as specified in this Section.
- B. Restrained Joints:
 - 1. General:
 - a. Unless otherwise indicated, restrained joints are required for all exposed and buried piping.
 - b. Unless otherwise indicated, restrained joints shall be flanged or grooved end for exposed service and push-on or grooved end for buried service.
 - 2. Push-On Joints:
 - a. As specified in Section 15062, modified for restraint.
 - b. Capable of being deflected after full assembly.
 - c. Joint assembly shall be in strict conformance with AWWA C600 and manufacturer's recommendations.
 - d. No field cuts of restrained pipe are permitted without prior approval of the Project Representative.
 - e. Acceptable manufacturer:
 - 1) American Cast Iron Pipe Company, Flex-Ring or Lok-Ring Joint.
 - 2) U.S. Pipe, TR Flex Joint.
 - 3) Approved Equal.
 - 3. Flange Assemblies:
 - a. Unless otherwise indicated, ductile iron, threaded-on flanges conforming to ANSI/AWWA A21.15/C115 or cast-on flanges conforming to ANSI/AWWA A21.10/C110.
 - b. Flanges shall be adequate for 250 psi working pressure.
 - c. Bolt circle and bolt holes shall match those of ANSI B16.1, Class 125 flanges and ANSI B16.5, Class 150 flanges.
 - d. Where specified, flanges shall be threaded-on or cast-on flanges conforming to ANSI B16.1, Class 250.

- e. Unless otherwise indicated, bolts and nuts for flange assemblies shall conform with specification Section 15085.
- f. Gaskets shall be as specified in this Section.
- 4. Grooved End Joints:
 - a. Couplings shall conform to AWWA C606.
 - b. Unless otherwise indicated, grooved end couplings shall be rigid joint for exposed service and flexible joint for buried service.
 - c. Bolts and nuts as specified in this Section.
 - d. Acceptable manufacturers:
 - 1) Victaulic Style 31.
 - 2) Approved Equal with flush seal type gasket designed for ductile iron pipe.
- 5. Mechanical Joints:
 - a. Where specified, restrained mechanical joints shall be the positive restraint type. Mechanical joints with retainer glands are not acceptable.
 - b. Locked mechanical hydrant tees, bends and adapters are an acceptable substitute for anchoring fire hydrants and valves to the pipe main.
- C. Bolts and Nuts:
 - 1. Corrosion-resistant, high-strength, low-alloy steel as specified in ANSI/AWWA C111/A21.11.
 - 2. Corrosion-resistant, stainless steel bolts and nuts for use with ductile iron joints are an acceptable substitute for alloyed bolts and nuts. Galvanized or cadmium-plated steel bolts and nuts are not acceptable substitutes for stainless steel.

2.06 PIPE COATING

- A. Surface preparation: Clean and abrade ductile iron pipe to obtain a surface profile of 1.5 to 2.0 mils.
- B. Base Coat: Apply one coat of moisture-cured urethane at 2-3 mil dry film thickness.
 - 1. Tenemic Series 1 Omnithane.
 - 2. Sherwin William's B65S14 Corothane 1 mio-aluminum.
 - 3. Approved Equal.
- C. Top Coat: per Section 09900 with System J-2, B-1, or C-1 depending on service environment.

2.07 POLYETHYLENE ENCASUREMENT TUBING

- A. Provide certification from an independent laboratory that polyethylene encasement meets the physical properties as listed in AWWA C105.
- B. Anti-Microbial, Low Density Polyethylene: 8 mil linear low density polyethylene film meeting the requirements of AWWA C105, impregnated anti-microbial compound and vapor phase inhibitor, "V-Bio".
- C. High Density Polyethylene: 4-mil high-density, cross-laminated polyethylene film meeting the requirements of AWWA C105.

2.08 PIPE LINING

- A. Cement Mortar Lining:
 - 1. Unless otherwise indicated, interior surfaces of pipe and fittings shall be cement mortar lined in accordance with AWWA C104.
 - 2. Cement shall be ASTM C150, Type II or V, low alkali, containing less than 0.60 percent alkalis.
- B. Asphaltic Lining: Where specified, pipe and fittings shall be lined with asphaltic material as specified in AWWA C151.

- C. Glass Lining:
1. Where specified, pipe and fittings shall be glass lined with a dual layer coating system of vitreous material to a minimum thickness of 10 mils.
 2. Glass lining shall provide continuous coverage as tested by a low voltage holiday detector with only isolated voids permitted due to casting anomalies. Voids, other than isolated pinholes, shall be cause for rejection.
 3. Ductile or cast iron pipe shall be bored, machined, or grit blasted to remove any voids, protrusions or surface irregularities to obtain a smooth continuous surface for glass lining.
 4. Pipe shall be at least Class 53 on diameters of 6 inches or greater except for pipe to be bored or machined which shall be of a suitable wall thickness to assure boring or machining will not impair minimum wall thickness required for Class 53. Four-inch pipe shall be Class 56.
 5. Fittings shall be ground or grit blasted to remove any voids, protrusions or surface irregularities.
 6. Acceptable manufacturers:
 - a. Ferrock MEH-32.
 - b. Vitco SG-14.
 - c. Approved Equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
1. Follow piping runs specified in the Drawings as closely as possible. Submit proposed deviations in accordance with Section 01300.
 2. Install pipe in accordance with AWWA C600.
 3. Make connections to existing structures and manholes so that the finished work will conform as nearly as practicable to the requirements specified for the new manholes, including necessary concrete work, cutting and shaping. Also specify concrete mortar shaping within any structure and manhole.
- B. Insulating Sections: Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, provide an insulating section as specified in Section 15085. Where buried metallic pipe is connected to above ground metallic piping, install insulating joints as specified in Section 15061.
- C. Anchorage:
1. All couplings and fittings shall be restrained joint for thrust restraint.
 2. Provide concrete thrust blocks only where indicated in the Drawings.
 3. Submit calculations and Drawings for proposed alternative thrust restraint or pipe anchorage.
- D. Polyethylene Tube:
1. Unless otherwise indicated, use polyethylene encasement for all buried ductile iron pipe. Install polyethylene as specified in AWWA C105 and these Specifications.
 2. Non-Potable Water Pipe: Provide dual layer encasement consisting of an inner wrap of 8-mil anti-microbial, low density polyethylene and an outer wrap of 4-mil high density polyethylene.
 3. Potable Water Pipe: Single wrap, 4-mil high density polyethylene.
 4. Wrapping:
 - a. Wrap buried pipe, fittings, valves, and couplings.
 - b. Prior to the placing of concrete, wrap fittings that require concrete backing.
 - c. Wrap the polyethylene tube seams and overlaps and hold in place by means of a 2-inch-wide plastic backed adhesive tape.

- d. Tape:
 - 1) The tape shall be such that the adhesive shall bond securely to both metal surfaces and polyethylene film.
 - 2) Acceptable manufacturers:
 - a) Polyken No. 900 (polyethylene).
 - b) Scotchwrap No. 50 (polyvinyl).
 - c) Approved Equal.
 - 3) Bedding and initial backfill for polyethylene wrapped pipe shall be a well-graded granular material which will not cut or damage the polyethylene tube during placement and backfilling.
 - 4) Sharp angular material over 0.5 inch shall not be used with polyethylene encasement.

E. Pipe Bonding and test stations:

- 1. Buried Pipe: Provide electrical bond across all pipe system joints to achieve electrical conductivity through the length of the pipe system. Bond in accordance with Section 13110 and the Drawings.

3.02 ACCEPTANCE TESTING

- A. Conduct hydrostatic pressure tests in accordance with Section 4 of AWWA C600 except that test pressures and allowable leakage shall be as listed in Section 15050.
- B. Conduct the tests in the presence of the Project Representative.

END OF SECTION

SECTION 15064

PLASTIC PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies polyvinylchloride (PVC), chlorinated polyvinylchloride (CPVC), polyethylene (PE) and polypropylene (PP) pipe and fittings.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM C1173	Flexible Transition Couplings for Underground Piping Systems
ASTM D1248	Polyethylene Plastics Extrusion Materials For Wire and Cable
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 D4101	Polypropylene Injection and Extrusion Materials
ASTM D2241	Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2513	Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
ASTM D2564	Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2665	Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2683	Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D2657	Heat Fusion Joining of Polyolefin Pipe and Fittings
ASTM D3034	Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3261	Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM D4101	Polypropylene Injection and Extrusion Materials
ASTM D5926	(PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
ASTM F402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F437	Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F441	Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
CSA B602	Mechanical Coupling for Drain, Waste, Vent Pipe, and Sewer Pipe

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's certificates of compliance with the specified standards.
- C. Contractor's layout drawings as specified in Section 15050.
- D. Manufacturer's Product data, catalog cuts, or shop drawings describing construction, dimensions, and materials. Indicate on the submittal each Piping System where the product will be used.

PART 2 PRODUCTS

2.01 PVC PIPE

- A. Pressure Pipe:
 - 1. Material for pipes and fittings: ASTM D1784, Class 12454-B.
 - 2. Pipe and fittings requirements: Either ASTM D1785 or ASTM D2241 for standard dimension ratios.
 - 3. 160-psi pipe--SDR 26; 200-psi pipe--SDR 21; 250-psi--SDR 17, as specified.
 - 4. Neoprene gaskets with push-on joints: ASTM F477.
 - 5. Schedule 80 PVC socket-type fittings: ASTM D2467.
 - 6. Schedule 40 PVC fittings: ASTM D2466.
 - 7. Schedule 80 PVC threaded fittings: ASTM D2464.
- B. Non-pressure Pipe:
 - 1. Material for pipe and fittings: ASTM D1784, Class 12454-B.
 - 2. Pipe and fittings requirements: ASTM D2665 and D3034.
 - 3. Teflon gaskets with push-on joints: ASTM F477.

2.02 CPVC PIPE

- A. Material for pipe and fittings: ASTM D1784, Class 23447-B.
- B. Pipe and fittings requirements: ASTM F441.
- C. Neoprene gaskets with push-on joints: ASTM F477.
- D. Schedule 80 CPVC socket type fittings: ASTM F439.
- E. Schedule 40 CPVC socket type fittings: ASTM F438.
- F. Schedule 80 CPVC threaded-type fittings: ASTM F437.

2.03 POLYETHYLENE PIPE AND FITTINGS (FOR NATURAL GAS PIPING)

- A. Polyethylene Pressure Pipe:
 - 1. ASTM D2513, PE2306, SDR11.5.
 - 2. Material: Natural polyethylene, ASTM D4101, Type II.
 - 3. Fittings: Fusion type.
- B. Polyethylene Pipe.
 - 1. PE 2406 conforming to ASTM D2513-96A and ASTM D2513-87.
 - 2. Material: Polyethylene resin shall be Chevron TR418Q or Solvay K38-20-160, (yellow in color) conforming to ASTM D3350.

3. Pipe and tubing shall have a hydrostatic design basis of at least 800 psi at 60 degC 140 degF.
4. Fittings: Socket type fittings conforming to ASTM D2683 or fusion type fittings conforming ASTM D3261, as applicable, in addition to the requirements of ASTM D2513-96A.

2.04 POLYPROPYLENE PIPE

- A. Pressure Pipe:
 1. Material for pipe and fittings: Polypropylene -- ASTM D4101, SDR 11, butt fusion type.
 2. 150 psi rated in all sizes.
 3. Heat fusion welding: in conformance with manufacturer's recommendation.
- B. Drain, Vent and Waste Pipe:
 1. Material for pipe and fittings: Flame retardant, Schedule 40, polypropylene (PPFR) plastic -- ASTM D4101.
 2. Pipe and fittings used for buried piping and in concealed locations: Joined by electrical fusion coils energized by a variable low-voltage power supply to completely fuse the interface between the pipe and socket and form a completely homogenous structure.
 3. Unless otherwise indicated, mechanical joint fittings may be used in exposed locations where future disassembly is desired.
 4. The mechanical joints shall be in conformance with the manufacturer's recommendation.

2.05 DOUBLE CONTAINMENT PVC PIPE

- A. General: Use as specified in Section 15050.
- B. Materials:
 1. Inner carrier pipe and fittings: Per Section 15050.
 2. Other containment piping and fittings: Clear unpigmented PVC conforming to ASTM D1784-90.
 3. Centralizers: PVC.
- C. Pipe and fittings:
 1. Inner Carrier Pipe and fittings: Per Section 15050.
 2. Outside Containment Pipe and fittings:
 - a. Solid or split longitudinally.
 - b. Fittings: Manufactured as two equal halves.
 - c. Pipe and fittings: Align via tongue and groove construction with joints welded together by injection bonding.
 - d. Fittings halves: Clipped together prior to injection bonding.
- D. Sample Wells:
 1. Provide sample wells consisting of a tee, 90-degree elbow, vertical standpipe and pressure-tight cap at low points along all double containment piping.
 2. Sample wells shall enable access to the invert of the outer containment piping for the purpose of collecting liquid samples from the annular containment volume.

2.06 FLANGE/UNIONS CONNECTIONS FOR PVC AND CPVC PIPE:

- A. Furnish flanges or unions at locations indicated in the Drawings and where indicated in this Section.
- B. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
- C. For pipe larger than 2 IN, provide 150 LB socket type PVC flange.
- D. For pipe 2 IN and less, provide socket type PVC union with Buna O-rings.

- E. Use flat, full faced natural rubber gaskets at flanged connections.
- F. Gaskets: Viton or PTFE.
- G. Furnish heavy hex head bolts, each with one (1) heavy hex nut, ASTM F593 Type 316 stainless steel.
- H. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other flanges.

2.07 SOLVENT WELD CEMENT FOR PVC AND CPVC PIPE

- A. Solvent: ASTM D2564 formulated and labeled for PVC and CPVC; formulated and labeled for use in the size and pressure rating of the pipe and labeled as resistant to caustic chemicals and hypochlorite solutions. Universal plastic pipe solvents are not acceptable.
- B. Primer: same manufacturer as the solvent; purple stain.
- C. Prior to solvent welding, clean joints of all loose debris and prime; primer shall stain pipe purple.
- D. Manufactures:
 - 1. Solvent: IPC Weld-On.
 - 2. Primer: IPC Weld-On.
 - 3. Approved Equal.

2.08 FLEXIBLE COUPLINGS

- A. Below Grade:
 - 1. Non-pressure service.
 - 2. Designed for PVC and CPVC pipe.
 - 3. Direct bury applications.
 - 4. Conforms to ASTM D5926 and C1173.
 - 5. Material: elastomeric polyvinyl chloride (PVC) with 316 stainless steel clamps.
 - 6. Temperature range: -30°F to 140°F.
 - 7. Pressure rating: 4.3 psi.
 - 8. Lateral deflection (offset): 0.5 inches per foot.
 - 9. Acceptable Manufacturers:
 - a. Fernco.
 - b. Approved Equal.
- B. Above Grade:
 - 1. Low profile quadruple arch design.
 - 2. Tube elastomer: EPDM.
 - 3. Cover elastomer: EPDM with UV resistant coating.
 - 4. Joint: flanged.
 - 5. Flange retained ring and hardware: 316 stainless steel installed with anti-seize lubricant.
 - 6. Temperature rating: 250°F.
 - 7. Pressure rating: 145 psig.
 - 8. Lateral deflection (offset): 8 inches.
 - 9. Acceptable Manufacturers:
 - a. Proco Model 234L.
 - b. Approved Equal.

2.09 PIPE COATING

- A. See Section 09900.

PART 3 EXECUTION

3.01 INSTALLATION

- A. PVC/CPVC pipe 3 inches in diameter and smaller:
 - 1. Join by means of socket fittings and solvent welding in conformance with ASTM F402.
 - 2. Make solvent-cemented joints in strict compliance with the manufacturer's/supplier's instructions and recommended procedures.

- B. PVC/CPVC pipe 4 inches in diameter and greater:
 - 1. Unless otherwise indicated, join by means of gasketed push-on joints and steel or ductile iron push-on or mechanical joint fittings.
 - 2. Line fittings: Line and coat as specified in Section 15061 or 15062.
 - 3. Unless otherwise indicated, paint PVC and CPVC piping exposed to sunlight with UV resistant coating system as specified in Section 09900.

- C. PE pipe and fittings:
 - 1. 4 inches in diameter and smaller: Unless otherwise indicated, join by means of thermal socket fusion.
 - 2. 6 inches in diameter and larger: Join by thermal butt fusion.
 - a. Perform butt-fusion joining of the pipes and fittings in accordance with procedures recommended by pipe manufacturer.
 - b. Tensile strength at yield of butt-fusion joints shall not be less than pipe.
 - c. Provide flanged adapters for connection to valves and where specified.

- D. Connections:
 - 1. Connect to different types of pipe by means of flanges, specified adapters or transition fittings.
 - 2. Where sleeve type couplings are used, uniformly torque both in accordance with pipe manufacturer's recommendation.
 - 3. Foreign material shall be removed from the pipe interior prior to assembly.

- E. Outside containment piping: Unless otherwise indicated, join in accordance with manufacturer's written instructions by means of injection bonding.

3.02 TESTING

- A. Per Section 15050.

END OF SECTION

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SECTION 15065

HIGH DENSITY POLYETHYLENE PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies high-density polyethylene (HDPE) pipe, fittings, and appurtenances. The designation HDPE is used in the piping system specification sheets (PIPESPEC) in Section 15050 and in this Section.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and the listed documents, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/AWWA C111/A21	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
ANSI/AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution
AWWA Manual M55	PE Pipe - Design and Installation.
ASTM A276	Stainless Steel Bars and Shapes
ASTM D2321	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2657	Heat Joining Polyolefin Pipe and Fittings
ASTM D3350	Polyethylene Plastics Pipe and Fittings Material
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194/A194M	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A240/A240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM F2164	Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure
ASTM F2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
Plastics Pipe Institute (PPI): Handbook of Polyethylene Pipe PPI TR 31	a. Technical Note 38, Bolt Torque for Polyethylene Flanged Joints. b. TR-33, Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe.
Code of Federal Regulations (CFR): Title 49 Part 192.285	Underground Installation of Polyolefin Piping Plastic Pipe: Qualifying Persons to Make Joints

- B. Affidavit of Compliance:
 - 1. The manufacturer shall furnish an affidavit of compliance conforming to the requirements of AWWA C906, Section 1.5, affirming that the piping components comply with the requirements of AWWA C906 and this Section.
 - 2. The affidavit shall be signed under penalty of perjury by an officer of the pipe manufacturer's company.
- C. Factory Tests: All HDPE materials, pipe and fittings shall be inspected and tested in accordance with the requirements of AWWA C906. The Engineer reserves the right to witness the factory testing. Notify the Project Representative and the Engineer at least 30 days prior to the factory tests.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Items to be submitted for this Specification:
 - 1. Shop drawings:
 - a. Catalog information confirming pipe, fittings, and other materials conform to requirements of this Section.
 - b. Drawings of specific connection details.
 - c. Manufacturer's recommended gasket material, thickness, bolt torque, and torque procedures to provide leak free connections based on pressure requirements at all bolted connections.
 - d. Detailed drawings showing the type and location of all fittings, joints, and connections to structures and manholes.
 - C. Informational Submittals:
 - 1. Infrared temperature gun product data.
 - 2. Certificates of qualification for persons to be fusing HDPE pipe. Experience and training record of persons to be fusing HDPE pipe.
 - 3. Testing Plan: Submit at least 15 days prior to testing and include the following as a minimum:
 - a. Testing dates.
 - b. Piping systems and section(s) to be tested.
 - c. Method of isolation.
 - d. Method of conveying water from source to system being tested.
 - 4. Certifications of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
 - 5. Test report documentation.
 - 6. Fusion parameters including recommended limits of criteria recorded by data logger.
 - 7. Fusion report for each joint, including information listed under Article Field Quality Control.
- D. Affidavit of Compliance.

1.04 SHIPMENT AND STORAGE

- A. The Contractor shall use care in handling and storage of the pipe. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging of the pipe. If the pipe shall be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The handling of the pipe shall be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.
- B. Sections of pipe with cuts, gouges, or scratches on the outside diameter (OD) surface that exceed 10 percent of the wall thickness of the pipe shall be removed completely and the ends of the pipeline rejoined. The inside diameter (ID) surface shall be free of cuts, gouges, and/or scratches.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Polyethylene resin shall meet or exceed requirements of ASTM D3350 for PE 4710 material with cell classification of 445474C, or better. Pressure rating shall be based on hydrostatic design stress of 1,000 psi at 73.4 degrees F.
- B. Bolts and nuts for buried mechanical joining components such as flanges shall be Type 316 stainless steel, ASTM A193/A193M, Grade B8 hex head bolts; and ASTM A194/A194M, Grade 8 hex head nuts.
- C. Gaskets: Material, size, and thickness shall be as recommended by pipe or flange manufacturer, and in accordance with PPI Technical Note 38.
- D. Wall Anchor:
 - 1. Material: Same as HDPE pipe.
 - 2. Internal Diameter: Equal to adjacent pipe.
 - 3. Shear Strength: Equal to or greater than tensile strength of adjacent pipe.
 - 4. Fabrication: Butt fusion. Extrusion bead welding is not allowed.
- E. Electrofusion Flex Restraint:
 - 1. Material: HDPE.
 - 2. Method of Attachment: Electrofusion.
 - 3. Designed for restraining movement of HDPE pipe.
 - 4. Manufacturers:
 - a. Central Plastics Company.
 - b. ISCO Industries.
- F. Backup Rings:
 - 1. Convolute for Flanged Connections:
 - a. ASTM A240/A240M, Type 316 stainless steel.
 - b. Complete with one-piece, molded polyethylene flange adapters.
 - c. Flanged Connections: Same or greater pressure rating as pipe.
- G. Bolts and nuts for exposed applications:
 - 1. ASTM A276 Type 316 stainless steel for locations with corrosive atmospheres as specified in Section 01450.
 - 2. Noncorrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any protective coating.

2.02 FEATURES

- A. Pipe: Pipe shall have the nominal dimensions shown with an IPS outside diameter basis and the dimensions and tolerances specified in AWWA C906. DR rating and pressure class shall be as specified in this Section.
- B. Pipe Performance Requirements:
 - 1. Dimension Ration (DR): 17, unless otherwise specified.
 - 2. Pressure Class: AWWA C906 - 100 psi, unless otherwise specified.
 - 3. Maximum deflection in installed condition, buried pipes: 4.2% of the average inside diameter.

C. Fittings:

1. Fittings shall conform to the applicable requirements of AWWA C906 for the joining methods specified in this Section.
2. Provide molded fittings for all fittings shown as a catalog item by manufacturer. Substitution of mitered, fabricated fittings is not allowed.
3. Pipe bends 14 inches and smaller: Where long radius bends are specified for the piping system in Section 15050, provide Arc™ sweep bends manufactured by Pipestar International, or Approved Equal. Bend radius shall be three times the pipe diameter, measured to the center line of the bend for long-radius bends.
4. Pipe bends larger than 14-inch diameter in size shall be mitered type with the following characteristics:

Degree of Bend	Minimum Number of Miter Segments
22.5	2
45	3
67.5	4
90	5

5. Match pipe DR for mitered bends and long radius bends.

D. Connections: Flange Type VR 955.

E. Pipe Supports for Exposed Applications:

1. Pipe supports shall conform to the applicable requirements of Section 15096.
2. Pipe shall be properly supported, thermal expansion and contraction movement shall be accommodated, and supports shall be spaced to limit vertical deflection between supports.
3. Pipe supports shall conform with the following additional requirements:
 - a. Supports shall cradle the bottom 120 degrees of the pipe.
 - b. Supports shall have a width (measured parallel to the pipe axis) at least one half of pipe diameter.
 - c. Edges of the supports shall be rounded or rolled to prevent cutting into the pipe.
 - d. Commercial pipe supports such as u-bolts, narrow strap-type hangers, and roller type supports are unsuitable unless modified for width and cradling.

F. Pipe Markings: Pipe marking shall conform to the requirements of AWWA C906.

PART 3 EXECUTION

3.01 INSTALLATION – BURIED APPLICATIONS

- A. Install polyethylene pipe in conformance with AWWA M55, PPI TR-33, ASTM F2620, and pipe manufacturer's recommendations.
- B. Alignment Procedures:
 1. Pipe and fittings shall be placed in the trench with the invert conforming to the elevations, slopes, and alignments shown.
- C. Joining: Butt-fuse pipes and fittings in accordance with pipe manufacturer's recommendations. Depending on Site conditions, perform butt-fusion joining in or outside of excavation.
 1. The pipe supplier shall be consulted to obtain machinery and expertise for the joining by butt-fusion of HDPE pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are adequately trained and qualified in the techniques involved as follows:

2. Persons fusing HDPE pipe shall be certified under 49 CFR § 192.285 and have minimum of 1 year of experience with fusing HDPE pipe and shall have received a minimum of 20 hours of training for fusing HDPE pipe from pipe supplier or fusing equipment supplier.
 3. Flanged joining, or other mechanical joining methods specified, may be used to make connections to differing piping materials, to equipment, valves and other appurtenances, and where specified.
 4. Internal beads at butt-fused joints shall be removed to produce a smooth interior surface across the joint where specified for the piping system in Section 15050.
 - a. Verify complete internal fusion bead removal was performed. Accomplish by examination of extracted internal fusion bead or by means of closed circuit television (CCTV) examination.
 - b. Extracted Internal Fusion Bead:
 - 1) Appearance shall have same double roll back semblance as does the external fusion bead.
 - 2) Possess smooth root cut, or pipe smoothness and shall be verified by means of closed circuit television (CCTV) examination.
 5. If HDPE pipe surface temperature is above 90 degrees F as measured with infrared temperature gun, allow pipe to cool prior to making any connections to flanges, existing pipeline systems, or structures.
 6. Connect HDPE pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems with flanged connections as follows:
 - a. Polyethylene flange adapter, thermally butt-fused to end of pipe. Flange "stub ends" are not allowed.
 - b. Convoluted backing flange.
 - c. Bolt and nut of sufficient length to show a minimum of three complete threads when joint is made and tightened to manufacturer's standard.
 - d. Use manufacturer recommended anti-seize for all threaded connections.
 - e. Follow requirements of PPI Technical Note 38 including mandatory 4-hour bolt re-torquing.
 - f. In addition and if different than PPI recommendations, follow manufacturers recommended bolt torque rating for manufacturers recommended gasket.
 7. Special Precautions at Flanges: Support polyethylene pipe connected to heavy fittings, manholes, and rigid structures in such a manner that no subsequent relative movement between polyethylene pipe at flanged joint and rigid structures is possible.
 8. Minimum Long-Term Field Bending Radius: Restricted to limits recommended by AWWA M55, Table 8-2.
- D. Placement in Trench:
1. Handle joined pipeline in such a manner that pipe is not damaged by dragging it over sharp and cutting objects.
 2. Position slings for handling pipeline away from butt-fused joints.
 3. Remove sections of damaged pipe and replace it with undamaged pipe. Damaged pipe is defined as pipe with kinks or gouges exceeding 10 percent of pipe wall thickness.
 4. Exercise care when lowering pipe into trench to prevent damage or twisting of pipe.
 5. Snake pipe from one side of trench to other to allow for thermal and settling movements, and as recommended by pipe manufacturer.
 6. At flanges, valves, and connections, excavate out trench bottom sufficiently to ensure clearance between undisturbed trench bottom and flange, valve, or connection.
- E. Trench Excavation: Trenches shall be excavated to ensure that sides will be stable under all working conditions. Trench walls or supports shall comply with all local and national standards for safety.
- F. Bedding and Backfill:
1. Materials used for bedding and backfill shall be as specified in Section 02200 and as shown.
 2. Place materials by methods that will not disturb or damage the pipe. All HDPE pipe shall be at the temperature of the surrounding soil at the time it is backfilled and compacted. Work in and tamp the bedding material in the area under the pipe and up to the spring line before placing and compacting the remainder of the embedment. Blocking under the pipe shall not be permitted.

3. Use compaction equipment and techniques that are compatible with materials specified and location in the trench. Before using heavy compaction or construction equipment directly over the pipe, place sufficient backfill to prevent damage, excessive deflections, or other disturbances of the pipe.

3.02 INSTALLATION – EXPOSED APPLICATIONS

- A. General: Unless otherwise specified, the piping system shall be installed in accordance with ASTM D2321, AWWA C906 and the manufacturer's recommendations.
- B. Joining:
 1. Pipe and fittings shall be joined into continuous lengths on the job site. Unless otherwise specified, joining shall be by the butt-fusion method performed in accordance with the pipe manufacturer's recommendations and ASTM D2657. Socket fusion, extrusion welding and hot gas welding is not allowed.
 2. The pipe supplier shall be consulted to obtain machinery and expertise for the joining by butt-fusion of HDPE pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are adequately trained and qualified in the techniques involved. Butt fusion joining shall yield a joint strength equal to or greater than the tensile strength of the pipe.
 3. Flanged joining, or other mechanical joining methods specified, may be used to make connections to differing piping materials, to equipment, valves and other appurtenances, and where specified.
 4. Victaulic Style 995 couplings shall be installed where indicated in the Drawings for pipeline disassembly for maintenance.

3.03 FIELD QUALITY CONTROL

- A. Joint Fusion:
 1. Measure and log each joint fusion by an electronic monitoring device (data logger) affixed to fusion machine, and shall be capable of being retrieved electronically. Data to be logged shall include the following:
 - a. Pipe size and dimensions.
 - b. Machine model and size.
 - c. Operator identification.
 - d. Job identification number.
 - e. Weld number.
 - f. Fusion, heating, and drag pressure settings.
 - g. Heater plate temperature.
 - h. Time stamp showing when weld was performed.
 - i. Heating and curing time of weld.
 - j. Curing temperature readings and time stamps of readings.
 - k. Error messages and warnings for out of range temperature or pressure settings.
 2. In addition to logged items above, the following shall be logged or annotated on report:
 - a. Location of joint being fused by pipeline station or by reference to pipe shop drawing.
 - b. Ambient temperature and humidity.
 - c. If internal bead was removed.
- B. Joint Weld Testing:
 1. Test Procedure: ASTM D638.
 2. Specimens: Cut pipe 12 inches on each side of field made joint. Rejoin ends and proceed with Work.
 3. Test Frequency:
 - a. First 1,000 Linear Feet: Two joints selected at random by Project Representative.
 - b. Each Additional 5,000 Linear Feet: One joint selected at random by Project Representative.
 - c. Each Test Failure: Two additional joints selected at random by Project Representative.

3.04 FIELD TESTING

- A. System Test Phase: Following the preoperational, and component test phases specified in Section 01660, perform the following field tests during the system test phase.
1. Hydrostatic Pressure Testing:
 - a. Buried pipelines shall be tested prior to backfilling the piping. Cover the pipe at intervals and/or at curves if necessary to hold the pipe in place during testing. Connections shall be left exposed for visual leak inspection.
 - b. After all free air is removed from the test section, the pressure in the pipe shall be raised at a steady rate to the required pressure. The pressure in the section shall be measured at the lowest point of the test section. Test pressure shall be as specified in Section 15050. The initial pressure shall be applied and allowed to stand without makeup pressure for 2 to 3 hours to allow for diametric expansion or pipe stretching to stabilize. After the equilibrium period, the test section shall be returned to the required test pressure and held for 3 hours. Amounts of makeup water allowable for expansion during the pressure test shall be as listed in the Plastic Pipe Institute PE Pipe Handbook Chapter 2. No visual leaks or pressure drops shall be observed during the final test period.
 2. Deflection Testing for Buried applications:
 - a. General: Deflection testing shall be performed on the entire length of installed pipe no sooner than 30 days after completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe and fittings in the installed pipeline under external loads shall not exceed the maximum deflection as specified within this Section. Either of the following devices and procedures may be used to measure deflection.
 - b. Pull-Through Deflection Testing: Determine whether the allowable deflection has been exceeded by use of a pull-through device.
 - c. Pull-Through Device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided that the device meets the applicable requirements specified in this Section, including those for diameter of the device. Ball, cylinder, or circular sections shall conform to the following:
 - 1) A diameter, or minor diameter as applicable, equal to the average inside diameter of the pipe minus the dimension equivalent of the maximum installed deflection specified in this Section. A tolerance of plus 0.5 percent in the diameter of the test device will be permitted.
 - 2) A homogeneous material throughout, with a density greater than 1.0 as related to water at 39.2 degrees F, and a surface Brinell hardness of not less than 150.
 - 3) Center bored and through bolted with a 1/4-inch minimum diameter steel shaft having a yield strength of not less than 70,000 pounds per square inch, with eyes or loops at each end for attaching pulling cables.
 - 4) Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.
 - d. Pull-Through Device Procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions as specified.
 - e. Deflection Device: Determine whether the allowable deflection has been exceeded by use of a deflection measuring device.
 - 1) Deflection Measuring Device: This device shall be sensitive to 1.0 percent of the diameter of the pipe being tested and accurate to 1.0 percent of the indicated dimension. The deflection measuring device shall be approved by the Project Representative prior to use.

- 2) Deflection Measuring Device Procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of the maximum allowable specified in this Section are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of the allowable, remove pipe which has excessive deflection, replace with new pipe, and completely retest in the same manner and under the same conditions.

END OF SECTION

SECTION 15066

COPPER PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies copper pipe and fittings.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision to the following documents. The references 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.

<u>Reference</u>	<u>Title</u>
ANSI B16.22	Wrought-Copper and Copper-Alloy Solder Joint Pressure Fittings
ANSI B16.26	Cast-Copper Alloy Fittings for Flared Copper Tubes
ASME B1.20.1	Pipe Threads, General Purpose
ASTM B32	Solder Metal
ASTM B88	Seamless Copper Water Tube

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data, catalog cuts, or shop drawings describing construction, dimensions, and materials. Indicate on the submittal each Piping System where the product will be used.

PART 2 PRODUCTS

2.01 PIPE

- A. Seamless copper tubing, ASTM B88. Unless otherwise specified, copper tubing shall be Type L, drawn, where used in exposed service and Type K, annealed or drawn for buried service.

2.02 CONNECTIONS

- A. Solder-type with taper threaded adapters for valves and other appurtenances. Taper threads shall comply with ASME B1.20.1.
- B. Solder: 95-5 tin-antimony, ASTM B32, Grade 95TA. Do not use cored solder.
- C. Thread Lubricant and Seal:
 - 1. Compressed air and Water: Teflon tape.

2.03 COUPLINGS AND FITTINGS

- A. 1/2-inch and smaller nominal diameter: compression type, brass or bronze, capable of holding the full bursting strength of the tubing complying with ANSI B16.26.

- B. Larger than 1/2-inch nominal diameter: wrought copper or bronze, solder joint pressure fittings, complying with ANSI B16.22.
- C. Piping reducers/enlargers shall be tapered. Bushing type adapters are not permitted.
- D. Acceptable Manufacturers for 1/2-inch and smaller nominal diameter:
 - 1. Swagelok.
 - 2. Gyrolok.
 - 3. Approved Equal.

PART 3 EXECUTION

3.01 FABRICATION

- A. Solder Joints:
 - 1. Cut tubing square and remove burrs.
 - 2. Immediately before soldering, clean both inside of fittings and outside of tubing with steel wool until bright.
 - 3. After cleaning, a paste flux shall be evenly and sparingly applied to the surfaces to be joined prior to soldering.
 - 4. Apply solder and pass flame toward the center of the fitting until the solder disappears.
 - 5. Remove all excess solder while still plastic.
 - 6. Do not use acid flux or acid wipe in making solder joints.
 - 7. Take care to prevent overheating.
- B. Takedown Couplings: screw union type.
 - 1. Where piping passes through walls or floors, takedown couplings shall be provided on both sides of the wall or floor and within two feet of the wall or floor.
 - 2. A takedown coupling shall be provided within two feet of each threaded end valve or appurtenance.
- C. Dielectric Protection:
 - 1. Copper tubing or fittings shall not be permitted to come in contact with steel piping, reinforcing steel, or other steel at any location.
 - 2. Electrical checks shall be made to assure no contact is made between copper tubing and steel elements.
 - 3. Wherever electrical contact is demonstrated by such tests, provide dielectric protection.

3.02 REPAIR

- A. Patching inserts, overlays, or pounding out of dents will not be permitted.
- B. Remove damaged ends as a cylinder and the section end properly prepared.

3.03 CLEANING

- A. Clean the interior of the pipe by swabbing.

3.04 TESTING

- A. As specified in Section 15050.

END OF SECTION

SECTION 15067

STAINLESS STEEL PIPING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies stainless steel pipe and fittings for ordinary service and high temperature stainless steel piping for engine exhaust.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ANSI/ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, 250, and 800
ANSI/ASME B16.11	Forged Steel Fittings, Socket Welding and Threaded.
ANSI/ASME B31.1	Code for Pressure Piping
ANSI/ASME B36.19	Welded and Seamless Wrought Steel Pipe
ASME Section IX	Boiler and Pressure Vessel Code; Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators
ASTM A182/A182M	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A194/A194M	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service
ASTM A240	Heat-Resisting Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General applications
ASTM A276	Stainless Steel Bars and Shapes
ASTM A312/A312M	Welded Austenitic Stainless Steel Pipes Alloy Steel Bolting
ASTM A320/A320M	Materials for Low-Temperature Service Wrought Austenitic
ASTM A380/A380M	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A403/A403M	Stainless Steel Piping Fittings
ASTM A409/A409M	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service
ASTM A480/A480M	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip
ASTM A774/A774M	As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
AWS D18.2	Guide to Weld Discoloration Levels on Inside of Austenitic Stainless Steel Tube
AWS QC1	Standard for Certification of Welding Inspectors

- B. Manufacturer:
 - 1. All shop fabricated stainless steel pipe and fittings shall be provided by a single manufacturer who is experienced and qualified in the manufacture and fabrication of the items to be provided. The pipe and fittings shall be shop-fabricated and field-installed in accordance with common industry wide practices and methods and shall comply with these specifications and referenced piping and welding codes.
- C. Mill Test Reports and Certifications:
 - 1. ASTM A312, paragraph 16.
 - 2. ASTM A403, paragraph 13.
 - 3. ASTM A409, paragraph 17.
- D. Welding:
 - 1. Welding shall conform to the requirements of ASME B31.3, Normal Fluid Service Category.
 - 2. Welding procedures shall be qualified by testing in accordance with ASME Section IX requirements.
 - 3. Welders shall be qualified by the Contractor or Fabricator in accordance with ASME Section IX. Contractor's shop and field welding inspectors shall hold current AWS QC1 CWI certification.

1.03 SUBMITTALS

- A. Procedure: Section 01300.
- B. Manufacturer's product data, catalog cuts.
- C. Shop drawings: Include complete descriptions of all base metals, dimensions, piping, fittings, couplings, dielectric connections, mechanical and welded joint locations and details, and types and locations of supports. Indicate on the submittal each Piping System where the product will be used.
- D. Welding Data: Welding procedures, welder performance qualification test records and Welder Log, welding inspector and nondestructive testing personnel certifications, nondestructive testing procedures.
- E. Mill test reports and certificates.
- F. Factory and shop test reports.

1.04 MARKING, SHIPPING, AND STORAGE

- A. All pipe, fittings, and fabrications shall be properly marked with type, gage, and heat number.
- B. All fabricated piping shall have openings plugged and flanges secured for storage and transport after fabrication.
- C. All fabricated piping shall be piece-marked with identifying numbers or codes which correspond to the Contractor's layout and installation drawings. The marks will be located on the spools at opposite ends and 180 degrees apart.
- D. Pipe spools shall be loaded and blocked and lagged as necessary to ensure protection from damage during shipping.
- E. Stainless steel pipe and fittings shall be stored on wood pallets and in accordance manufacturer's recommendations. Dents, gouges, and scratches in stainless steel pipe and fittings are not acceptable and are reason for rejecting pipe and fittings.

PART 2 PRODUCTS

2.01 PIPE

- A. 2 ½-inch and smaller: ASTM A312, Type 316L, seamless. Minimum wall thickness: Schedule 40S.
- B. 3-inch and Larger: Unless otherwise indicated, manufactured from ASTM A240 annealed and pickled sheets and plates, Type 316L, in accordance with ASTM A778 or ASTM A409 HT-0. Use only extra-low carbon (ELC) materials with .03 percent maximum carbon. Pipe shall be manufactured to nominal pipe sizes as listed in ANSI B36.19, Table 2, and shall have the following nominal wall thickness:

NOMINAL PIPE SIZE INCHES	SCHEDULE GAGE/PLATE
3 to 4	Schedule 10S
5 to 8	Schedule 10S
10	Schedule 10S
12	Schedule 10S

2.02 FITTINGS

- A. 2-1/2-inches and Smaller: Stainless steel, ASTM A403, of the same material and pressure rating as the pipe, threaded long radius with dimensions conforming to ASME B16.11.
- B. 3-Inches and Larger:
 - 1. Unless otherwise indicated, butt-weld type manufactured in accordance with ASTM A774 of the same material and in the same thicknesses as the pipe.
 - 2. Long radius elbows up to 24 inches in diameter shall be smooth flow. All short radius, special radius, and reducing elbows and long radius elbows greater than 24 inches in diameter shall be of mitered construction.
 - 3. Reducers shall be straight tapered, cone type.
 - 4. Tees, crosses, laterals, and wyes shall be shop-fabricated from pipe.

2.03 JOINTS

- A. General: Stainless steel pipe fabricated into spool pieces shall have shop-welded circumferential butt-weld joints or flanges.
- B. Flanged Joints:
 - 1. Unless otherwise indicated, comply with AWWA C228, Class SD.

2.04 COUPLINGS

- A. General: Fabricated stainless steel piping shall be shop-prepared for pipe couplings where specified. Unless otherwise indicated, couplings shall be arched-band or grooved type.
- B. Sleeve Type:
 - 1. Where specified, of standard steel construction as specified Section 15085.
 - 2. Pipe: Plain-end with external weld beads ground smooth to ensure proper gasket seating.
 - 3. Pressure pipe lines: Sleeve coupling joints shall be restrained by the use of harness rods connecting across the joint to flange lugs on adjacent flange joints. Where no adjacent flange joints exist, stainless steel harness lugs shall be welded to the pipe to receive the harness rods.

- C. Arched-Band Type:
 1. Stainless steel of the same material and wall thickness as the pipe.
 2. Fixed--FxF, Expansion--ExE, or Fixed by Expansion--FxE as specified or as required.
 3. Pipe: Plain-end with external weld beads ground smooth and with S.S. restraining rings shop-welded to the piping for fixed type couplings.
 4. Acceptable manufacturers:
 - a. Brico, Depend-0-Lok type.
 - b. Approved Equal.
- D. Grooved-End (Split) Type:
 1. Malleable iron or ductile iron as specified in Section 15085 except that submerged couplings shall be the same material as the pipe.
 2. Pipe ends: Roll-grooved to the coupling manufacturer's specifications. Where roll grooving is impractical, the pipe shall have heavy-wall machine-grooved pipe nipples or machined ring collars fully welded to the pipe or fitting.
 3. Nipples: Taper-bored to the I.D. of the adjoining pipe to allow full-weld penetration, and made of the same alloy as the piping.
 4. Collars: Welded on both sides to the piping, and made of the same alloy as the piping.
- E. Expansion Type: Unless otherwise indicated, flanged rubber arch type as specified in Section 15090. Provide pipe flanges for these couplings.

2.05 THREADED CONNECTIONS

- A. Threaded pipe, gage, or instrument connections: Made using stainless steel, 150-pound, threaded half-couplings conforming to ASTM A182 or ASTM A276. Shop welded to the pipe at the locations specified.

2.06 GASKETS

- A. Unless otherwise indicated, as specified in the PIPESPECS and in specification Section 15085.
 1. For air lines: EPDM suitable for use at temperatures to 240 degrees F.

2.07 BOLTS

- A. Bolts, nuts, and washers for stainless steel flange assemblies and stainless steel couplings: Same material, conforming to ASTM A320 for low-temperature service and ASTM A193 and ASTM A194 for high-temperature service.
 1. Bolts, nuts and washers for other couplings: As specified in referenced paragraphs for the couplings.

2.08 PIPE SUPPORT SYSTEMS

- A. Unless otherwise indicated, all hangers, rods, structural attachments, and other components of support systems for stainless steel pipe shall be of the same materials as the pipe and conform to Section 15096.

2.09 FINISH

- A. After all shop operations have been completed, pipe and fittings shall be pickled and passivated in manufacturer's plant, and scrubbed and washed until discoloration and possible iron picked up from manufacturing process are removed.

- B. Standard Finish:
 - 1. 16-gage through 8-gage material: No. 1 or 28 per ASTM A480.
 - 2. 3/16-inch and heavier plate material: No. 1 mill finish or better per ASTM A480.

PART 3 EXECUTION

3.01 PIPE CUTTING, THREADING, AND JOINTING

- A. Pipe cutting, threading, and jointing shall conform to the requirements of ANSI B31.1. Lubricate all pipe threads with Teflon tape.

3.02 WELDING

- A. General:
 - 1. Butt welded. Use GTAW and purge pipe interior with inert gas before welding. Use inert shielding and backing gas during welding.
 - 2. Limit heat tint oxide to No. 4 or less on inside and outside of pipe, as defined by AWS D18.2.
 - 3. Remove excessive weld deposits, slag, spatter, and projections by grinding. Grind smooth welds on gasket surfaces.
 - 4. Use couplings and prefabrication of pipe systems at the factory to minimize field welding to the greatest extent possible.
- B. Preparation of Surfaces to be Welded:
 - 1. Surfaces of joints to be welded free from mill scale, slag, grease, oil, paint, rust, and other foreign material.
 - 2. Wire brush joints to be welded with stainless steel wire brushes and precisely fit before welding.
- C. Field Welding:
 - 1. Perform welding only when the surfaces are completely free of any moisture.
 - 2. Do not weld when wind speed exceeds 5 mph, ambient temperature is lower than 32 deg. F, or during periods of rain or snow, unless the areas being welded are properly shielded.
- D. Tack Welds, Clips, and Other Attachments:
 - 1. Repair nicks, gouges, notches, and depressions in the base metal in the area of the before the joint weld is made.
 - 2. Remove tack welds, clips, and other attachments and repair defects, except where the tack welds occur within the weld area and these tack welds do not exceed the size of the completed weld. Cracked tack welds shall be removed.
 - 3. Grind areas to be repaired down to clean metal and then repair by building up with weld metal. Grind the repaired areas smooth to form a plane surface with the base metal.
- E. Defects and Repairs:
 - 1. Remove and repair all welding that does not comply with referenced welding codes and standards.
 - 2. Do not perform calking or peening of welds to correct defects.
 - 3. Enlarge welds found deficient in dimension but not in quality by additional welding after thoroughly cleaning the surface of previously deposited metal and the adjoining plate.
 - 4. Remove weld deposits, slag, weld spatter, and projections inside the pipe by grinding.

3.03 FABRICATION AND INSTALLATION REQUIREMENTS

- A. Fabricator and Contractor shall use extreme care to avoid carbon impregnation on stainless steel surfaces.
 - 1. All saws, drills, files, wire brushes, etc. shall be used for stainless steel piping only.
 - 2. Pipe storage and fabrication racks shall be nonferrous, stainless steel or rubber-lined.

3. Use nylon slings or straps for handling stainless steel piping.
4. After installation, wash and rinse all foreign matter from the piping surface.
5. Treat all welded joints with a pickling solution, brush with stainless steel wire brushes and rinse clean.
6. If carbon impregnation occurs, clean and passivate affected surfaces in accordance with ASTM A380.

3.04 COATINGS

- A. After installation, paint all steel or iron flanges, couplings, and appurtenances in accordance with Section 09900.
 1. Painting of the stainless steel pipe is not required.
 - a. Be responsible for supplying and installing the stainless steel piping with a consistently clean surface.
 - b. Remove identifying spool piece marks with paint thinner or solvents and wash the entire stainless steel surface with detergent and hot water and rinse clean.

END OF SECTION

SECTION 15069

FIBERGLASS REINFORCED POLYMER PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies gasketed fiberglass reinforced polymer pipe (FRPP) and fittings to be used for open trench installation of pressurized sanitary sewer, combined sewer, and storm drainage applications.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of a conflict between the requirements of this Section and the listed documents, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM D2412	Standard Test Method for Determining External Loading Characteristics of Plastic Pipe by Parallel Plate Loading
ASTM D3262	Standard Specification for Fiberglass ((Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D3754	Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer and Industrial Pressure Pipe
ASTM D4161	Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F477	Elastomeric Gaskets
AWWA M45	Fiberglass Pipe Design
ISO 8533	Plastics piping systems for pressure and non-pressure drainage and sewerage -- Glass-reinforced thermosetting plastics (GRP) systems based on unsaturated polyester (UP) resin -- Test methods to prove the design of cemented or wrapped joints.

- B. Qualifications:
1. Pipe manufacturer: Five years experience manufacturing FRPP of size similar to those required by the Contract.
 2. Contractor's personnel installing and joining FRPP with field laminated joints shall have experience meeting the following criteria:
 - a. Contractor's personnel shall have previously demonstrated experience with installing a minimum of 10 field laminated joints with a minimum operating pressure of 15 psi within the last 24 months, or shall be trained by the FRPP manufacturer's representative.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Qualifications.
1. Names of personal performing field laminating of joints, number of joints previously completed, and operating pressure of the previously completed joints.
 2. In lieu of experience, a manufacturer's representative shall train the personnel.

- C. Fabrication Information and Shop Drawings: Illustrate details of wall thickness, pipe joint, joint gasket.
 - 1. Details of wall thickness, pipe joint, and joint gasket.
 - 2. Details of miter bends and splices for fittings.
 - 3. Gasket details shall include the diameter of the cross section and the circumferential length.
 - 4. Pipeline alignment and grade.
 - 5. Pipe/fitting wall construction details:
 - a. Pipe cylinder type and thickness.
 - b. Manufacturing tolerances.
 - 6. Gasketed joints:
 - a. Joint design type and details.
 - 7. Flanged joints:
 - a. Joint design type and details.
 - 8. Line layout and marking diagrams:
 - a. Designation or serial number of each pipe section and fitting.
 - b. Location and direction of each pipe section type and fitting in completed line.
 - c. Pipe station and invert elevation of each pipe section laid.
 - d. Elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature.
 - e. Station limits of each reach for each type of field joint and backfill.
 - f. Details and locations of required inspection, injection, and grout ports and other pipe appurtenances.
 - g. Details, locations, and structural design calculations for pipe restraint and all proposed methods required to prevent pipe movement and excessive pipe wall stresses for hydrostatic joint testing of pipeline.
 - h. Details and locations of closures for length adjustment and for construction convenience.
 - i. Details of specials and fittings, including outlets, elbows and connections:
 - 1) Design for internal pressure (circumferential and longitudinal) and external loading conditions.
 - 9. Restrained Field Laminated Joints:
 - a. Joint design and design type.
 - b. Wrapping materials, adherents and resins.
 - c. Joint details.
 - d. Joint installation requirements and procedures.
 - e. Method(s) of repairing joint leaks.
- D. Layout Drawings.
 - 1. The location of each pipe section and special piece, with each piece numbered or otherwise designated in sequence.
 - 2. All outlets and bends to be made up into special lengths so that when installed they will be located as indicated in the Drawings.
 - 3. Show each pipe and fitting marked on the outside and inside to indicate the location sequence number on the laying plan.
- E. Product Data and Design Calculations:
 - 1. Manufacturer's product data indicating: handling and storage requirements.
 - 2. Manufacturer's written product installation and repair procedures.
 - 3. Glass Reinforcement: type and brand.
 - 4. Physical and chemical analysis of resin system:
 - a. Type and brand.
 - b. Physical and chemical analysis.
 - 5. Sand: type and gradation.
 - 6. Additives: type and brand.
 - 7. Method(s) of repairing joint leaks.
 - 8. Design Calculations:

- a. Lamination sequence of the restrained joint system designed to a test pressure of 15 psi. Such design shall be provided by the pipe manufacturer. Design shall be signed and stamped by an engineer licensed in the state of Washington.
- F. Factory Testing.
- G. Testing Certification.
1. Certified copies of laboratory test reports showing conformance with the specified requirements for each of the following:
 - a. Glass reinforcement.
 - b. Aggregates.
 - c. Joint gaskets.
 2. Letter from independent testing agency certifying that pipe provided meets requirements of this Section.
- H. Manufacturer's Certificates.
1. Manufacturer's Certificate of Compliance: Products provided shall meet the following requirements:
 - a. Submit prior to shipment of product or material.
 - b. Project Representative may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
 - c. Signed by product manufacturer certifying that product or material provided conforms to or exceeds the Specifications. Attach supporting reference data, affidavits, and certifications as appropriate.
 - d. May reflect recent or previous test results on material or product, if acceptable to Project Representative.
 2. Certified statement from manufacturer of gaskets, setting forth that basic polymer used in gaskets and test results of physical properties of compound are in accordance with ASTM F477 for FRP pipe.
 3. Certified statement from manufacturer of compliance for all pipes, specials, fittings, and other products or materials furnished under this Section as specified in ASTM D3754.
 4. Compliance for all hydrostatic leak tests.
- I. Manufacturer's In-Plant Quality Control Program: Quality control procedures and materials testing to be used throughout the manufacturing process. Submit fabrication plan prior to manufacture of any pipe for this Project.
1. Plant quality control recordkeeping.
 2. Fiberglass reinforced polymer fabrication process.
 3. Physical testing methods and procedures for the fiberglass reinforced polymer pipe.
 4. Curing methods.
 5. Repair methods and limits of repairs.
 6. Pipe storage and handling requirements at the Site.
 7. Shipping and transportation methods from the plant to the Site.
- J. Field Testing:
1. Field testing plan of the joints
 2. Field testing results of the joints.
- K. Restrained laminated joint installation verification report submitted by manufacturer's representative.

PART 2 PRODUCTS

2.01 FIBERGLASS REINFORCED POLYMER PIPE (FRPP)

- A. Minimum stiffness class: Per Section 15050.
- B. Minimum pressure class: Per Section 15050.
- C. Deflection: Maximum allowable long term deflection shall be 5 percent of the inside diameter.
- D. Acceptable Manufacturers:
 - 1. Hobas Pipe USA
 - 2. Thompson Pipe Group-Flowtite.
 - 3. Approved Equal.
- E. Pipe manufacturer shall design and detail the pipe.
- F. Materials:
 - 1. Pipe:
 - a. Glass fiber reinforcement thermosetting polyester resin and sand proportioned and oriented so as to meet physical requirements when tested in accordance with ASTM D3262.
 - b. Physical requirements:
 - 1) Cell limits:
 - a) Type: 1.
 - b) Liner: 1 or 2.
 - c) Grade: 1 or 3.
 - c. Wall thickness shall not vary from that indicated in the accepted design submittal by more than plus 1/4-inch or minus zero-inch for any pipe.
 - d. Nominal lengths of 10 or 20 feet through the pipe length.
 - e. Length of the sides shall not vary more than 1/4-inch in any length of pipe.
 - f. Fiberglass reinforcing shall be randomly oriented.
 - g. Pipe sections shall be joined by field-connected joints that utilize elastomeric sealing gaskets as the sole means to maintain water tightness.
 - 2. Resin systems: Use only polyester resin systems that have been used for pipe manufacture for a minimum of ten years.
 - 3. Glass Reinforcements:
 - a. The reinforcing glass fibers shall be of the highest quality commercial grade of E-glass filaments with binder and sizing compatible with the impregnating resins.
 - b. Chopped fibers shall have a length between 1- and 2-inches.
 - 4. Silica Sand: Sand shall be minimum 98 percent silica with maximum moisture content of 0.2 percent.
 - 5. Additives: Resin additives, such as curing agents, pigments, dyes, fillers, and thixotropic agents shall not detrimentally affect the performance of the pipe.
 - 6. Use a single pipe manufacturer for furnishing pipe, specials, fittings, and appurtenances such as gaskets for each pipe section.
 - 7. Pipe Joint:
 - a. Gasketed Joint:
 - 1) Structural filament wound sleeve coupling.
 - 2) Overwrapped and mechanically locked to an internal full face EPDM elastomeric gasket.
 - b. Joint mating length: provide allowance for manufacturer's allowable joint deflection, preset joint opening to allow for joint deflection, and allowances as necessary to ensure positive gasket sealing during joint movement.
 - c. Fittings:
 - 1) Unless otherwise indicated, fittings shall be fabricated from pipe meeting the requirements of this Section.

- 2) Fittings can be contact molded, filament wound, or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays. Bend radius to be a minimum of 1.5 times the pipe diameter.
 - d. Flanged Joints:
 - 1) Where indicated, the pipe shall be connected to other pipe or fittings with flanges.
 - 2) The pipe manufacturer shall determine the flange thickness and specify the type of gasket required to meet the sealing requirements of ASTM D4161. FRP flanges may be glassed to the pipe if the design meets design requirements. FRP flange back-up rings shall be provided per manufacturer's recommendation. Flange and back-up rings to be to be compatible with ANSI Class 125 bolt hole pattern.
 - 3) Back-up rings, gaskets, bolts, nuts, and washers shall provide a long-term service pressure rating equal to the pipe for which the flanged connection will be used and be approved for use by the manufacturer.
 - 4) Back-up rings, bolts, nuts, and washers shall be corrosion-resistant Type 316 stainless steel and compatible with the materials of the connecting pipes.
 - 5) Gasket materials shall be compatible with the internal fluid and external environment per the gasket manufacturer's recommendations and shall have an inner diameter matching the pipe for which the flange assembly will be used.
 - e. Restrained Laminated Joints:
 - 1) Where indicated on the drawings for the 60-inch EFF pipe, the pipe shall be field connected with a tapered fiberglass laminate as the sole means to maintain joint water tightness and to transfer axial loads as a method for thrust restraint.
 - 2) Wrap ply reinforcement, adherents, resins and additives to be as defined by the pipe manufacturer.
 - 3) The joints shall be designed by the pipe manufacturer to meet the performance requirements of ISO 8533.
 8. Elastomeric Gaskets:
 - a. In accordance with ASTM F477.
 - b. Composition of the elastomer shall be suitable for domestic wastewater applications.
 9. Inspection and Injection Port:
 - a. Stainless steel material.
 - b. Epoxy fill: Compatible with FRPP.
 10. Internal corrosion liner shall consist of a minimum thickness of 0.04 inches.
 11. Outside pipe coating:
 - a. Minimum thickness of 0.03 inches.
 - b. Thermosetting polyester resin or thermosetting polyester resin/sand composite.
 12. Pipe ends:
 - a. Right angles (90 degrees) to the centerline axis of the pipe.
 - b. Permissible variation from a true plane at 90-degree angle shall not exceed 1/8-inch.
- G. If used as a Carrier Pipe inside a casing, design and select pipe for the loads and conditions anticipated for installation including heat of hydration and grouting pressures.
- H. Factory Testing:
1. Pipe shall be tested as a pipe under pressure to twice the rated pressure class of the pipe without showing leakage.
 2. Test or historical performance data to verify that joint design meets requirements of these specifications.
 3. Plan for plant testing of joints in shear.
 4. Results of Source Quality Control testing.
 5. The Project Representative reserves the right to witness the factory testing. Inform the Project Representative at least 30 days prior to the factory tests.
 6. Laminated restrained joint test reports. Reports from previous projects of similar diameter and operating pressure of 15 psi or higher are acceptable.

2.02 FABRICATION

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Georgetown Wet Weather Treatment Station 15069 - 5 FIBERGLASS REINFORCED POLYMER PIPE

- A. Provide 30 day written notice prior to start of pipe fabrication.
- B. Provide within 30 days following completion of pipe fabrication:
 - 1. Dimensional check report.
 - 2. Split-ring test report.
- C. Delivery of Pipe Sections: Factory test results, independent testing laboratory certifications, and fabrication and manufacture certifications shall be submitted to the Project Representative prior to delivery or at the time of delivery.

2.03 SOURCE QUALITY CONTROL

- A. Factory testing:
 - 1. Notify the Project Representative a minimum of 14 days prior to the testing so the Project Representative may witness the tests if desired.
 - 2. Pipes shall be manufactured and tested in accordance with ASTM D3262.
 - 3. Joints shall meet the requirements of ASTM D4161.
 - 4. Restrained Field Laminated Joints shall meet the requirements of ISO 8533.
 - 5. After completion of fabrication, test pipe in accordance with ASTM D3262:
 - a. Stiffness shall be tested in accordance with ASTM D2412.

2.04 DELIVERY, STORAGE, AND HANDLING

- A. Mark, package, handle, and ship in accordance with the manufacturer's recommendations and requirements of ASTM D3754.
- B. Pipe shall be unloaded using a forklift with fork arms long enough to reach beyond the last pipe in the bundle. Do not roll the pipe off the truck. Use proper tools and equipment acceptable to the manufacturer to handle the pipe.
- C. Pipe shall not be handled using chain or cable slings or chokers.
- D. Slings shall be made of non-metallic webbing such as nylon or textile material that will not damage the pipe.
- E. Stockpiled pipe shall be supported on sand or earth berms free of rock exceeding three inches in diameter.
- F. Store pipe in accordance with the requirements of AWWA M45 and the manufacturer's recommendations.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Notify Project Representative immediately of manufacturing imperfections or damage caused by improper handling. Mark all such pipe and remove to offsite storage area immediately.
- B. Verify size, pipe condition, and pipe class prior to installation of pipe.
- C. Repairs to FRPP pipe section will be allowed only if a repair procedure is submitted and accepted in writing by Project Representative. Damaged pipe which, in opinion of Project Representative, cannot be repaired, will be rejected and removed to offsite storage area immediately.

- D. In unloading, the pipe shall be handled with appropriate equipment to avoid sudden impact or damage. Under no circumstances shall pipe be dropped. Pipe shall not be skidded or rolled against pipe already on the ground.
- E. When multiple-level stacking is necessary for storage, contact the pipe manufacturer for recommendations that will prevent possible damage to the pipe.
- F. Provide pipe and pipe joint test results with delivery of pipe. Do not deliver pipe not meeting test requirements to the Site.

3.02 PREPARATION

- A. Pipe Distribution: Do not distribute more than one week's supply of materials in advance of laying, unless otherwise authorized by Project Representative.
- B. Inspect pipe and fittings prior to lowering into trench to ensure no cracked, broken, or otherwise defective materials are being used. Do not install damaged or cracked pipes.
- C. Remove foreign matter and dirt from inside of pipe and fittings and keep clean during and after laying. Wash ends of section clean with wet brush prior to joining sections of pipe.

3.03 INSTALLATION

- A. General:
 - 1. Install pipe sections in accordance with manufacturer's recommendations.
 - 2. Provide and use proper implements, tools, and facilities for safe and proper prosecution of Work.
 - 3. Lower pipe, fittings, and appurtenances into trench, piece by piece, using slings or other suitable tools and equipment, in such a manner as to prevent damage to pipe materials, protective coatings, and linings. Do not drop or dump pipe into trenches.
 - 4. Type and preparation of bedding and initial and subsequent backfill shall be as specified in Section 02221 and as indicated in the Drawings. Pipe shall be laid with uniform bearing under the full length of the barrel of the pipe. In general, pipe laying shall proceed upgrade with bells upstream. The interior of the pipeline shall be cleaned as the work progresses.
- B. Line and Grade:
 - 1. Establish line and grade for pipe by use of lasers.
 - 2. Measure for grade at pipe invert, not at top of pipe.
 - 3. Do not deviate from line or grade, as indicated in the Drawings, more than 1/2 inch, provided that such variation does not result in a level or reverse sloping invert.
- C. Laying and Jointing:
 - 1. Use gasket lubricant as recommended by gasket manufacturer.
 - 2. Lay pipe upgrade with bell ends pointing in direction of laying sequenced per the layout drawings.
 - 3. When field cutting or machining pipe is necessary, use only tools and methods recommended by pipe manufacturer and approved by Project Representative.
 - 4. After a section of pipe has been placed in its approximate position for jointing, clean end of pipe to be joined, inside of joint, and rubber ring immediately before joining pipe.
 - 5. Assemble joint in accordance with recommendations of manufacturer.
 - 6. Apply sufficient pressure in making joint to assure that joint is "home" as defined in standard installation instructions provided by pipe manufacturer. Inside joint space shall not exceed 25 percent of pipe manufacturer's recommended maximum allowance.
 - 7. Restrained laminated joints shall be installed in accordance with the approved submittals and as recommended by the pipe manufacturer.
 - 8. Place pipe to specified line and grade to form smooth flow line.
 - 9. Ensure that bottom of pipe is in contact with pipe bedding for full length of each section.
 - 10. Check for alignment and grade after joint has been made.

11. Secure the pipe from movement before next joint is installed.
12. When laying operations are not in progress, and at close of day's work, close and block open end of last laid section of pipe to prevent entry of foreign material or creep of gasketed joints.
13. Take precautions to prevent "uplift" or floating of line prior to completion of backfill operation.

3.04 CLEANING

- A. Clean each section of completed pipeline prior to testing.
- B. Place screen or dam in downstream manhole of section being cleaned to catch debris.
- C. Remove material from each section before cleaning the next section downstream.
- D. Method: Hand sweeping.
- E. Cleaning water may be discharged into existing sewer system after screening and removal of debris.

3.05 FIELD JOINT AIR TESTS

- A. After backfilling, FRPP shall be inspected for obstruction and shall be cleaned. Provide all the necessary facilities for the inspection and cleaning and shall dispose of all waste, including water.
- B. Provide all labor and equipment to perform the test. Test pressure shall be measured at the crown of the pipe. The equipment shall be capable of accurately monitoring and recording the required test information. All pipe shall be tested by the joint test method. Pipe shall be tested as a pipe under pressure to twice the rated pressure class of the pipe without showing leakage.
- C. Joint Test:
 1. Pipe joint pressure testing criteria:
 - a. Pressure test each pipe joint using portable pipe joint tester.
 - b. Test prior to installation of backfill.
 - c. Test Medium: water.
 - d. Test pressure: twice the rated pressure class of the pipe without showing leakage.
 2. Pipe joint tester:
 - a. Pressure cylinder, which fits inside pipe, straddles pipe joint and isolates and pressurizes a section of pipe.
 - b. Elastomeric sealing elements encircle the joint tester body so when inflated or deformed they affect seal between the joint tester body and the interior surface of the pipe.
 - c. Data plate: References pipe diameter, rated test pressure, inflation pressure and any torque requirements for threaded fasteners.
 3. Joint pressure test procedure:
 - a. Gasketed joint:
 - 1) Maintain test pressure for a minimum two minutes.
 - 2) Visually inspect and mark any leaks indicated by escaping gas bubbles or water.
 - 3) Leakage criteria: One psi pressure drop in two minutes allowed.
 - 4) Repair joint leaks, which do not meet the leakage criteria.
- D. Each joint shall be tested. The testing shall be done in accordance with the following sequence:
 1. All testing shall be done after the pipe has been backfilled and prior to grout pointing of joints.
 2. After laying the first 100 feet of each size of pipe, and before laying any additional pipes of that size, the first 100 feet shall be tested.
 3. After successful testing of the first 100 feet of each size of pipe, proceed with placing the remainder of that size of pipe. Testing shall proceed so that not more than 100 feet of pipe shall be laid in advance of the last joint test.

4. Where the actual leakage exceeds the allowable, determine the cause and remedy it before the pipeline is accepted. Correct any visible leaks in the pipeline. The procedure shall be submitted to the Project Representative for review.
- E. Notify Project Representative in writing five days in advance of any testing. Perform all testing in presence of Project Representative.

3.06 FIELD INSPECTION

- A. Pipe shall be inspected by a walk-through with visual and video recorded inspection. Acceptance of the pipeline shall be based on a final inspection conducted by Project Representative.
 1. Manual Inspection:
 - a. Provide any safety and specialized equipment required for inspection for Project Representative.
 - b. Maintain voice communications between in-pipe and aboveground personnel at all times during in-pipe inspection.
 - c. Record inspection on digital formatted video and Inspection Logs: Provide digital color photographs of defects or other features as requested by Project Representative.
 - d. Log Sheets: Show time and date of inspection, location, upstream and downstream structure numbers, pipeline length, pipe size, pipe segment length, pipe material, lateral connections located by pipe segment number, and location and detail of defects encountered.
 - B. Deficiencies Requiring Correction:
 1. Variations in alignment greater than specified herein.
 2. Failed joint pressure test.
 3. Rolled or damaged gaskets.
 4. Cracks greater than specified herein.
 5. Visible infiltration or evidence of infiltration.
 6. Presence of debris or foreign objects.
 7. Obvious damage or defects in pipeline.

3.07 PIPE MANUFACTURER FIELD SERVICES

- A. Pipe manufacturer's representative shall train and qualify the contractor's personnel on recommended methods and procedures for installing field laminated joints. Manufacturer's representative shall oversee, confirm and submit verification report that the field laminated joint installation for at least three joints is installed in accordance with manufacturer recommended installation methods and procedures for field quality control.

END OF SECTION

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SECTION 15073

ACID-RESISTANT CAST IRON SOIL PIPE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies acid-resistant cast-iron soil piping, fittings, and appurtenances.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM A518	Corrosion-Resistant High-Silicon Iron Castings
FS QQ-C-40	Calking: Lead Wool and Lead Pig

- B. Provide joint type specifically approved by applicable plumbing code.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data, catalog cuts, or shop drawings describing construction, dimensions, and materials. Indicate on the submittal each Piping System where the product will be used.
- C. Contractor's layout drawings as specified in Section 15050.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Piping:
 - 1. The Duriron Company.
 - 2. Approved Equal.
- B. Packing:
 - 1. Sealtite (#321).
 - 2. Approved Equal.

2.02 PIPE BARREL, JOINTS, AND FITTINGS

- A. Pipe and Fittings:
 - 1. ASTM A518.
 - 2. 14-1/2 percent silicon cast iron.
 - 3. Brinell hardness: 520.
 - 4. Tensile strength: 20,000 psi.
- B. Joints:
 - 1. Standard joints:
 - a. Joint packing: Acid resisting.
 - b. Joint packing containment: Lead, FS QQ-C-40, Type 1.

2. Mechanical joints:
 - a. Inner liner:
 - 1) Teflon.
 - 2) Continuous.
 - 3) One-piece.
 - 4) Sintered.
 - 5) Non-porous.
 - b. Outer sleeve:
 - 1) Neoprene.
 - 2) Continuous.
 - 3) One-piece.
 - c. Outer clamp:
 - 1) Stainless steel.
 - 2) Two (2) bolts minimum.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Observe manufacturer's recommendation for handling, cutting, jointing, installing, and testing.
- B. Support exposed piping in accordance with Section 15096.
- C. Install buried piping in accordance with Section 15050.
- D. If "standard joint" is used, assure lead is run in one (1) continuous pour.
 1. No second pouring or driving of lead is permitted.
 2. Provide minimum of 12 OZ of lead per inch of pipe diameter per joint.

3.02 FIELD QUALITY CONTROL

- A. Test piping systems in accordance with Section 15050.

END OF SECTION

SECTION 15075

JOINT GASKETS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies rubber gaskets for push-on compression type joints used with fabricated steel pipe, steel pipe, and cement mortar lined and coated steel pipe.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM D395	Rubber Property-Compression Set
ASTM D412	Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D471	Rubber Property-Effect of Liquids
ASTM D573	Rubber-Deterioration in an Air Oven
ASTM D1149	Rubber Deterioration-Surface Ozone Cracking in a Chamber
ASTM D2240	Rubber Property - Durometer Hardness

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Certified copies of test reports indicating that the gasket material has been tested and that the results of the tests comply with the requirements specified.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Compound:
 - 1. Synthetic rubber with neoprene or nitrile elastomer.
 - 2. Containing no less than 50 percent by volume elastomer.
 - 3. Free from factice, reclaimed elastomer, and other deleterious substances.
- B. Gasket: Containing no asbestos.

2.02 PHYSICAL REQUIREMENTS

- A. Physical requirement shall conform to the results of the following tests, in accordance with the specified ASTM standards:
 - 1. Tensile strength (ASTM D412):
 - a. 1,500 psi minimum, with ultimate elongation at 425 percent minimum.
 - 2. Hardness (ASTM D2240, Type A durometer):
 - a. Initial test:
 - 1) Pipe diameters less than 90 inches: Minimum hardness of 45 +5.

- b. Subsequent test:
 - 1) Condition test specimen and durometer at minus 10 degrees C for 48 hours, then test.
 - 2) The increase in hardness over the initial test value shall not exceed 15 points.
- 3. Compression set (ASTM D395):
 - a. Not to exceed 20 percent when compressed for 22 hours at 70 degrees C.
 - b. Test specimens:
 - 1) Circular discs cut from the gaskets.
 - 2) Height: 0.500 (+0.005 - 0.025) inches.
 - 3) Diameter: That of the gasket, but not to exceed 1.129 +0.010 inches.
- 4. Aging (ASTM D573):
 - a. Less than 20 percent reduction in tensile strength.
 - b. Less than 40 percent reduction in ultimate elongation.
 - c. Less than 15 points increase in hardness.
 - d. Test specimens:
 - 1) Circular discs cut from the gaskets.
 - 2) Thickness: 0.080 +0.005 inches.
- 5. Effect of liquids (ASTM D471): The maximum volume change in oil and in water shall be as follows:
 - a. Oil: 100 percent in ASTM oil No. 3.
 - b. Water: 15 percent.
- 6. Ozone cracking (ASTM D1149):
 - a. Test specimen: A gasket loop mounted to give at least 20 percent elongation.
 - b. There shall be no cracking visible at 2 times magnification of the gasket after 100 hours exposure to 1 mg/l ozone at 40 degrees C.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and Section 15050.

END OF SECTION

SECTION 15085

PIPING CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies the following methods of connecting piping, flanges, threading, mechanical couplings, dielectric unions, and welding.
- B. The scheduling and planning investigation of compatibility, furnishing, installing, testing for all connections, including coordinating rating, sizes, diameters, bolt sizes and bolt circle, gasket and flange facing and material plus the use of dielectric insulation for dissimilar metals including connecting to existing facilities and equipment.
- C. Unless otherwise specified, connections of piping at equipment shall comply with the requirements of this Section.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B18.2.1	Square and Hex Bolts and Screws Inch Series
ASME B18.2.2	Square and Hex Nuts (Inch Series)
ASME B31.1	Power Piping
ASME B31.3	Process Piping
ASME Section IX	Boiler and Pressure Vessel Code; Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators
ASTM F37	Sealability of Gasket Materials
ASTM F104	Nonmetallic Gasket Materials
ASTM F152	Tension Testing of Nonmetallic Gasket Materials
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service-Size 4 in. through 144 in.
AWWA C606	Grooved and Shouldered Joints
AWWA M11	Steel Pipe-A Guide for Design and Installation

- B. Welding:
 - 1. Welding shall conform to the requirements of ASME B31.3, Normal Fluid Service Category or AWWA C206.
 - 2. Welding procedures shall be qualified by testing in accordance with ASME Section IX requirements.
 - 3. Welders shall be qualified by the Contractor or Fabricator in accordance with ASME Section IX.
 - 4. Contractor's shop and field welding inspectors shall hold current AWS QC1 CWI certification.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's catalog data showing piping connection details for each piping system.
- C. Details for installation for each type of piping connection.
- D. Statement by the supplier for each type of item that the materials provided are suitable for the liquid and piping materials and pressures as well as the installation situation and environment.
- E. Welders Qualification and certification.

PART 2 PRODUCTS

2.01 GENERAL

- A. Pipe connections (joint and fitting) options for a particular piping system shall be as specified in the PIPESPEC sheet in Section 15050.
- B. Takedown Couplings: provide for all piping systems in accordance with this Section; provide both around equipment and at standard pipe lengths for all straight runs of pipe.
- C. Continuous welding for straight runs of pipe is acceptable only where the individual PIPESPEC sheet allows welding as a connection option. Where connections are shown, then the connections shall be specifically where shown, however, if several connection options are allowed for the particular piping system on the PIPESPEC sheet, then any option may be consistently used, i.e., if flanged or rigid grooved connections are acceptable and grooved are shown, then flanged may be substituted. Integrity of rigid, non-rotating connections shall be maintained at all valves and other equipment.

2.02 FLANGE ASSEMBLIES

- A. Flanges:
 - 1. General:
 - a. Flanges shall flat face flanges as specified in the following paragraphs.
 - b. Flat faced flanges shall not be bolted to raised face flanges directly.
 - c. When connecting raised face flanges to flat face flanges, the raised face shall be refaced to be flush or a compensation spacer, as specified in this Section, shall be used.
 - 2. Flat Face Flanges:
 - a. Ductile and Cast iron flanges: Faced in accordance with ASME B16.1. Where companion flanges are used, the flanges on pipe shall be refaced to be flush with the companion flange face.
 - b. Steel flanges: AWWA C207, Class D. AWWA C207, Class E flanges shall be provided where test pressure exceeds 175 psi.
- B. Gaskets:
 - 1. Material: See Section 15050.
 - 2. For flat faced flanges: In accordance with AWWA C207.
- C. Bolts, Washers and Nuts:
 - 1. ASME B18.2.1 standard square or hexagon head bolts with ASME B18.2.2 standard hexagon nuts.
 - 2. Threads: ASME B1.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B.
 - 3. Length: In conformance with ASME B16.5.

4. Unless otherwise specified, carbon steel machined bolts with hot pressed hexagon nuts.
5. Bolts, washers and nuts for submerged service and where located over open basins: Made of Type 316 stainless steel in conformance with ASTM F593 and ASTM F594, markings F593F and F594F.
6. Bolts, washers and nuts for buried service, including for use in vaults: Made of noncorrosive high-strength, low-alloy steel having the characteristics specified in AWWA C111/A21, regardless of any other protective coating.

D. Compensation Spacers:

1. PTFE or HDPE
2. Thickness to match the raised face of flange.
3. Drilled holes to match the flanges.
4. Acceptable manufacturers:
 - a. Tri-Clor.
 - b. Micromold Products.
 - c. Approved Equal.

2.03 MECHANICAL COUPLINGS

A. Sleeve-Type Couplings:

1. Acceptable manufacturer:
 - a. Sleeve-type mechanical pipe couplings:
 - 1) Smith- Blair Type 411.
 - 2) Dresser Style 38.
 - 3) Approved Equal, with the stop removed from the middle ring.
 - b. Reducing couplings:
 - 1) Smith-Blair Type 415.
 - 2) Dresser Style 62.
 - 3) Approved Equal.
 - c. Sleeve-type flanged coupling adapters:
 - 1) Smith-Blair Type 913.
 - 2) Dresser Style 128.
 - 3) Approved Equal.
 - d. Insulating couplings:
 - 1) Smith-Blair Type 416.
 - 2) Dresser Style 39.
 - 3) Romac IC501.
 - 4) Approved Equal.
2. Bolts, washers, nuts and overall coupling materials:
 - a. For submerged and headspace service: Made of Type 316 stainless steel in conformance with ASTM F593 and ASTM F594, markings F593F and F594F.
 - b. For buried service: Made of noncorrosive high-strength, low-alloy steel having the characteristics specified in AWWA C111/A21, regardless of any other protective coating.

B. Plain End Couplings:

1. Acceptable Manufacturer:
 - a. Pipe sizes 6 inches and smaller (Schedule 80):
 - 1) Victaulic Style 99.
 - 2) Approved Equal.
 - b. Pipe sizes 6 inches and smaller (lighter weight):
 - 1) Victaulic Style 90.
 - 2) Approved Equal.
 - c. Pipe sizes 8 inches and larger:
 - 1) Victaulic Style 99.
 - 2) Approved Equal.
2. Bolts and nuts: Unless otherwise specified, shall comply with AWWA C606.

- C. Grooved End (Split Ring) Couplings:
1. Acceptable manufacturer:
 - a. Grooved end flexible-type couplings:
 - 1) Victaulic Style 77.
 - 2) Approved Equal.
 - b. Grooved end rigid-type couplings:
 - 1) Victaulic Style 07 Zero-Flex.
 - 2) Approved Equal.
 - c. Grooved end flanged coupling adapters:
 - 1) Victaulic Style 741.
 - 2) Approved Equal.
 - d. Snap-joint grooved end couplings:
 - 1) Victaulic Style 78.
 - 2) Approved Equal.
 2. Flexible-type couplings shall be used for all piping greater than 12 inches in diameter; for pipe 12 inches in diameter and less in rack-mounted tunnel piping applications; and for grooved joints adjacent to pump or blower suction and discharge where grooved couplings are used for noise and vibration control. All other applications for piping 12 inches in diameter and less shall utilize rigid-type couplings, or for Ductile Iron pipe, use rigid type grooving.
 3. Cut grooves are not permitted on fabricated or light wall pipe. Note that Ductile Iron pipe shall meet minimum wall thickness for use of grooving, per AWWA C606.
 4. Bolts, washers, nuts and overall coupling materials:
 - a. Unless otherwise specified, shall comply with AWWA C606.
 - b. For submerged and headspace service: Type 316 stainless steel in conformance with ASTM F593 and ASTM F594, markings F593F and F594F.
 - c. For buried service: Made of noncorrosive high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any other protective coating.

2.04 DISMANTLING JOINT

- A. Meet the dimensional requirements of ANSI Class 125 bolt circles.
- B. Flange Spool: AWWA Class D ring flange.
 1. 3 inch through 12 inch pipe: schedule 40 ASTM A53 carbon steel.
 2. 14 inch through 72 inch pipe: ASTM A36 carbon steel.
- C. End Ring & Body:
 1. 3 inch through 12 inch pipe: ASTM A536, ductile iron, grade 65-45-12.
 2. 14 inch through 72 inch pipe: ASTM A36 carbon steel with AWWA C207 Class D flanges.
- D. Tie-Rods: High tensile steel per ASTM A193, grade B7.
- E. Bolts & Nuts: ASTM A325 or A307. ASTM A588 HSLA bolt material.
- F. Coating: fusion bonded epoxy.
- G. Acceptable Manufacturers:
 1. Romac DJ400.
 2. Smith Blair 972.

2.05 THREAD

- A. Pipe thread dimensions and size limits shall conform to ASME B1.20.1.

2.06 UNIONS

- A. 2 inches and smaller: Ground joint screwed pattern unions.
- B. 2-1/2 inches and larger: Ground joint flange unions.
- C. Dielectric unions: Match the pipe material except bronze may be used with copper piping.
- D. Hydraulic power and petroleum conveying piping shall use flat-faced O-ring style unions, for both regular and dielectric unions. O-ring material shall be suitable for piped fluid.

2.07 COATINGS

- A. Unless otherwise specified, flange assemblies and mechanical type couplings for buried installation shall be field coated with the same coatings as the piping system where the flanges and couplings are installed or as specified in Section 09900.

2.08 FLEXIBLE COUPLINGS

- A. Buried applications at transition from facility mechanical piping to yard piping:
 - 1. Dual Dresser type couplings with AWWA M11 harness:
 - a. Romac Type 501.
 - b. Dresser Style 38.
 - 2. Dual Ball joint type:
 - a. EBAA Iron type Flex-Tend.
 - b. ROMAC type Fj Restraint.
 - 3. Approved Equal.
- B. Coated and/or wrapped to provide corrosion protection equivalent to adjacent buried piping as required for piping material.

PART 3 EXECUTION

3.01 PIPE CUTTING, THREADING AND JOINTING

- A. Pipe cutting, threading and jointing shall conform to the requirements of ASME B31.1.

3.02 GROOVE COUPLING

- A. Groove coupling pipe cuts shall be per the pipe manufacturer's recommendations.
- B. All pipe groove cuts shall be implemented from outside surface of the pipe. No pipe groove cutting equipment shall touch interior finish surface of pipes neither for alignment or support. No damages to the original interior surface of the pipes during groove coupling cuts.

3.03 PIPE WELDING

- A. Weld only in presence of Contractor's Certified Welding Inspector. Qualified, written welding procedures are required.
- B. Make welds in accordance with the requirements of ASME/ANSI B31.1, ASME/ANSI B31.3, AWWA C206 and AWS D1.1. Field welding of ductile iron is not allowed.

3.04 TAKEDOWN COUPLINGS

- A. Screw unions, flanged or grooved end mechanical coupling type joints and provided as specified.
- B. Employ flanged or grooved end joints on pipelines 2-1/2 inches in diameter and larger.
- C. Where piping passes through walls, and for all connections to equipment, unless otherwise indicated, provide takedown couplings within 3 feet of the wall.
- D. Provide a union or flanged connection within 2 feet of each threaded end valve.
- E. Provide Sleeve Coupling for suction and discharge of all pumps, restrained.
- F. Provide Flexible Vibration reduction couplings on the suction and discharge of all air compressors and blowers, restrained.

3.05 FLEXIBILITY

- A. Unless otherwise indicated, for piping 2 inches in diameter and larger passing from concrete to earth, provide two pipe couplings or flexible joints with one coupling as close as possible but not more than 2 feet from the edge of the structure or encasement unless otherwise indicated in the Drawings.
- B. Restrain all flexible joints used on pressurized ductile iron pipe. Lugs for restraint on ductile iron pipe to be factory installed.

3.06 DIELECTRIC CONNECTIONS

- A. Provide an insulating section of rubber or plastic pipe where a copper pipe is connected to steel or cast iron pipe. The insulating section shall have a minimum length of 12 pipe diameters.
- B. Dielectric unions as specified may be used instead of the specified insulating sections. Where copper pipe is supported from hangers insulate it from the hangers or use copper-plated hangers.

END OF SECTION

SECTION 15090

EXPANSION JOINTS AND FLEXIBLE METAL HOSE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies piping expansion joints and flexible metal hose.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
EJMA STDS	Standards of Expansion Joint Manufacturers' Association.

1.03 SUBMITTALS

- A. Section 01300: Procedure.
- B. Manufacturer's catalog data, including dimensions, materials of construction and allowable deflection.
- C. Product data.
- D. Design and construction details of formed metal bellows type expansion joints.
- E. Pressure thrust force and spring rate data for formed bellows expansion joints.
- F. Details for installation of all expansion joints.
- G. Integrate all submittals for this Section with Sections 15050, 15090, 15096, and 15097, and submit as part of submittal requirements in Section 15050.

PART 2 PRODUCTS

2.01 PERFORMANCE AND SERVICE CONDITIONS

- A. Expansion joints shall be designed in accordance with EJMA Standards for pressure and service as specified in PIPESPEC of Section 15050.
- B. Ambient temperature range: 25 to 95 DegF.
- C. Flexible metal hose shall be suitable for a line pressure equal to the test pressure listed in the PIPESPEC.
- D. Design Requirements:
 - 1. Flexible Metal Hose: Live lengths for flexible metal hose shall be based upon the service conditions listed in this Section and have a design life of 1,000,000 full displacement cycles.
 - 2. Expansion Joints: Corrugated type expansion joints shall be suitable for a minimum of 10,000 pressure, temperature and deflection cycles (non-concurrent).

2.02 EXPANSION JOINTS

A. Metal Construction:

1. Formed Bellows Type:

a. Medium Temperature (up to 800 degrees F):

- 1) Having 300 series stainless steel multi-ply bellows rated for the specified design temperature and pressure.
- 2) Test pressures: Specified in Section 15050. Each expansion joint shall be factory tested at the test pressure.
- 3) Ductwork expansion joints: May be rated at less than 50 psig but shall be rated equal to the design pressure and, in no case, less than 2 psig.
- 4) Engine and gas turbine exhaust expansion joints: As specified in Section 15090.
- 5) Design: Determined by the amount and kind of movement specified (axial, lateral, angular).
- 6) End connections: Unless otherwise specified, flanged.
- 7) Acceptable manufacturers:
 - a) Flexonics, Inc.
 - b) Hyspan Precision Products, Inc.
 - c) American BOA Inc.
 - d) Approved Equal.

b. High Temperature (up to 2000 degrees F):

- 1) Engine and gas turbine exhaust expansion joints: Multi-ply bellows type designed for 15 psig.
- 2) Bellows: Constructed of 300 series stainless steel.
- 3) End connections: Unless otherwise specified, either the fixed flange or Vanstone flange configuration.
- 4) Flange material: Carbon steel for temperatures up to 1000 degrees F and stainless steel for temperatures above 1000 degrees F. Vanstone materials and flow liners, where specified, shall be the same as bellows material.
- 5) Acceptable manufacturers:
 - a) GT Exhaust System.
 - b) Flexonics DEX Series.
 - c) Hyspan Series 2500.
 - d) American BOA Series 025E.
 - e) Approved Equal.

2. Steel Expansion Compensator Type:

- a. Having 2-ply stainless steel bellows and carbon steel shroud and end fittings.
- b. Rated for 175 psi maximum working pressure and 750 degrees F.
- c. Acceptable manufacturers:
 - 1) Flexonics Model H Expansion Compensator.
 - 2) Hyspan Series 8500.
 - 3) Keflex 7Q.
 - 4) Approved Equal.

3. Bronze Expansion Compensator Type:

- a. Having multi-ply phosphor bronze or stainless steel bellows and copper tube end fittings.
- b. Rated for 150 psi maximum working pressure and 400 degrees F.
- c. Acceptable manufacturers:
 - 1) Flexonics Model HB Expansion Compensator.
 - 2) Hyspan Series 8500.
 - 3) Keflex 70.
 - 4) American BOA Inc.
 - 5) Approved Equal.

B. Elastomer and Fabric Construction:

1. General:

- a. Standard spool arch type or the precision molded spherical design type as indicated or specified.
- b. Expansion joint connectors: Having control units (restraints) to prevent excessive axial elongation and to accept the static pressure thrust in the piping system. Number and sizes of control rods or restraints shall be as determined by the manufacturer.
- c. Single arch and sphere type expansion joints: Unless otherwise indicated, have 6-inch face-to-face dimension for pipe up to 8 inches and 8-inch face-to-face dimension for pipe 10 and 12 inches. For use with larger diameters, Contractor shall obtain approval from the Project Representative.
- d. Cover elastomer: Chlorobutyl, neoprene or EPDM.
- e. Tube elastomer: For temperatures between 180 and 240 degrees F, chlorobutyl or EPDM. Neoprene or Buna N liners are acceptable for temperatures to 180 degrees F.
- f. For raw sewer system the expansion joints material shall be compatible for sewer application. Provide certificate from the manufacturer for sewer application.

2. Spool Type:

- a. Resilient arch type and standard or tapered as specified. Unless otherwise specified, all tapered connectors shall be eccentric.
- b. Constructed of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body.
- c. Retaining rings or backup rings:
 - 1) Provide for standard arch type expansion joints suitable for the specified temperature and pressure.
 - 2) 3/8-inch thick steel, split, either galvanized, zinc shield coated, or as indicated in the Drawings.
- d. Filled arch type shall be used on all piping systems carrying fluids containing solids.
- e. Acceptable manufacturers:
 - 1) Single, multiple, or filled arch:
 - a) Mason Style EJBN.
 - b) Garlock Style 204.
 - c) Mercer Style 500.
 - d) Goodall Style E-1462.
 - e) General Style 1025.
 - f) Approved Equal.
 - 2) High pressure couplings suitable for 240 degree F operating temperatures:
 - a) Mason Style EJBN-HD.
 - b) Mercer Style 510.
 - c) Garlock Style 204-HP.
 - d) Goodall Style E-1489.
 - e) General Style 1015.
 - f) Approved Equal.

3. Spherical Molded Type:

- a. Precision molded of multiple plies of nylon tire cord fabric and elastomer suitable for specified temperature and pressure.
- b. Having steel or ductile iron floating flanges, and no metal parts shall coming in contact with the fluid.
- c. Acceptable manufacturer (single sphere molded connectors):
 - 1) Mason Type MFNC.
 - 2) Mercer Type 5500.
 - 3) Goodall Type E-611.
 - 4) General Type 1010.
 - 5) Garlock Style 8100.
 - 6) Approved Equal.
- d. Double sphere or triple sphere connectors shall be provided where required to provide for the specified movement.

- C. Other Constructions:
 - 1. Polyvinylchloride:
 - a. Acceptable manufacturers:
 - 1) Celanese "Chemtrol" CPVC slip type having Teflon impregnated seal rings.
 - 2) Certain-teed Fluid Tite PVC.
 - 3) Johns-Manville PVC double bell expansion joint.
 - 4) Approved Equal.
 - 2. Teflon:
 - a. Molded TFE bellows.
 - b. Acceptable manufacturers:
 - 1) Metraflex T-2.
 - 2) Garlock Style 215.
 - 3) Resistoflex R-6905.
 - 4) EGG Style M-150.
 - 5) Approved Equal.

2.03 FLEXIBLE METAL HOSE

- A. General:
 - 1. Unless otherwise indicated, corrugated type 321 stainless steel with stainless steel fittings and provided with stainless steel single braid.
 - 2. End connections: Attached by the heliarc welding process using stainless steel welding rod.
 - 3. Bronze flexible metal hose shall be provided for copper and brass systems.
- B. Braided Type:
 - 1. Type A:
 - a. Acceptable manufacturers:
 - 1) Flexonics Series 401M/402M.
 - 2) Flexweld USFWSS-31/32.
 - 3) American BOA Series B.
 - 4) Approved Equal.
 - 2. Type B:
 - a. Acceptable manufacturers:
 - 1) Flexonics Series 301.
 - 2) Flexweld USFWB-31.
 - 3) American BOA Series B.
 - 4) Approved Equal.

2.04 TEFLON FLEXIBLE CONNECTORS

- A. Consist of molded Teflon bellows and 150-pound ductile iron flanges.
- B. Flanges: Completely isolated from the chemical by the molded Teflon bellows.
- C. Integral steel limit bolts and Monel reinforcing rings shall be provided on the connectors.
- D. Gaskets: Non-asbestos.
- E. The connectors shall allow for an axial transverse movement of at least 1/2-inch, and an offset of at least 3/8-inch.
- F. Rated for a pressure of 130 psi at a temperature of 70 degrees F.

- G. Acceptable manufacturers:
 1. Metraflex Teflon Expansion Joint.
 2. Garlock, modified as necessary to provide the specified features.
 3. Approved Equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Locate expansion joints and anchors as specified. Location and number of guides shall be determined from EJMA Standards.
- B. Do not install expansion joints during times of extreme temperature or in a fully compressed or fully expanded condition.
- C. Unless otherwise indicated in the Drawings, thrust control shackles/rods shall be required for expansion joints 4 inches and larger to control distortion from pressure expansion.

3.02 ALIGNMENT

- A. Align piping systems prior to installation of expansion joints.
- B. Do not use expansion joints to correct piping misalignment during installations.
- C. Expansion joints shall be preset at the factory for rated axial compression and expansion. Install the expansion joints at the factory preset condition.

3.03 EXPANSION JOINT AND CONNECTOR SCHEDULE

- A. Expansion joints and/or flexible metal hose connectors provided for specific equipment items or piping systems are specified on the following schedule. The piping systems expansion joints shall be installed as indicated in the Drawings and/or as required for isolation vibration system Section 11021. The expansion joints shall be provided to meet the piping system and equipment installation requirements and design criteria, including temperature, pressure and movement for each joint, are indicated in the Drawings.

TYPE OF EXPANSION JOINT CONNECTOR	TYPE OF SERVICE/USE
Metal Construction Formed Bellows Type; Medium temperature (2.02 A.1.a)	Hot and chilled water, jacket water, steam, high pressure air, and gas and steel pipe lines subjected to ambient temperature differentials sufficient to require expansion joints.
Metal Construction Formed Bellows Type; High temperature (2.02 A.1.b)	Engine and gas turbine exhaust to meet the engine temperature and sufficient for the required vibration and expansion.
Metal Construction Steel Expansion Compensator Type (2.02 A.2.)	Same type service/use as for "Formed Metal Bellow Type medium Temperature expansion joint" except size of piping is limited to 3-inch diameter or less.
Metal Construction Bronze Expansion Compensator Type (2.02 A.3)	Medium temperature copper piping
Elastomer and Fabric Construction Spool arch Type (2.02 B.2.)	Pump/blower connectors and expansion joints for piping 14 inch diameter and larger. Except for steam and chemical lines.

TYPE OF EXPANSION JOINT CONNECTOR	TYPE OF SERVICE/USE
Elastomer and Fabric Construction Elastomer Spherical Molded Type (2.02 B.3)	Pump/blower connectors and expansion joints for piping 12 inch diameter and less. Except for steam and chemical lines.
PVC Construction (2.02 C.1)	PVC piping.
Teflon Construction (2.02 C.2)	FRP containment piping.
Flexible Metal Hose Stainless Steel Braided Hose (2.03 B.1.)	Air and gas compressor discharge connections.
Flexible Metal Hose Bronze Braided Hose (2.03 B.2.)	Air compressor discharge and pump connectors for copper lines.
Teflon Flexible Connector (2.04)	Connection of PVC piping to polyethylene chemical storage tanks.

END OF SECTION

SECTION 15092

WALL PENETRATION SEALS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies wall penetration mechanical seals and sealants for above and below grade pipe penetrations (non-fire-rated construction).

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM C920	Standard Specification for Elastomeric Joint Sealants.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. The following information shall be provided in accordance with Section 01300:
 - 1. Manufacturer's product data including descriptive literature about the material and installation procedures.
 - 2. Acknowledgement that products submitted meet the requirements of standards referenced.

PART 2 PRODUCTS

2.01 MASTIC SEALANTS FOR PENETRATIONS

- A. General:
 - 1. Provide colors matching materials being sealed.
 - 2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
 - 3. Nonsagging sealant for vertical and overhead applications.
 - 4. Sealants for horizontal joints at grade: Self-leveling pedestrian/traffic grade.
 - 5. Backer rod: see Section 07900.
- B. Polyurethane:
 - 1. Acceptable Manufacturers:
 - a. Pecora Dynatrol-IXL, Dynatrol II, Urexpan NR-200, NR-201.
 - b. Sika Chemical Corporation Sikaflex-1a, Sikaflex-2C NS/SL.
 - c. Sonneborn Sonolastic NP-1, NP-II, SL-1 SL-2.
 - d. Tremco Dymonic or Dymeric, Vulkem 116,227,45,245.
 - e. Approved Equal.
 - 2. Materials:
 - a. One (1) or two (2) components.
 - b. Paintable.
 - c. Meet ASTM C920 Type S or Type M, Grade NS or P, Class 25, Use NT, T, M, A and O.

- C. Silicone:
 - 1. Acceptable Manufacturers:
 - a. General Electric: Silpruf, Silglaze II.
 - b. General Electric: Sanitary 1700 sealant for sealing around plumbing fixtures.
 - c. Dow Corning: 786 for sealing around plumbing fixtures.
 - d. Dow Corning: 790, 795.
 - e. Tremco: Spectrem 1, Spectrem 3, Tremsil 600.
 - f. Approved Equal.
 - 2. Materials:
 - a. One (1) component.
 - b. Mildew resistant for sealing around plumbing fixtures.
 - c. Meet ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, O.

- D. Polysulfide:
 - 1. Acceptable Manufacturers:
 - a. Pecora Synthacalk GC2+.
 - b. Sonneborn - Sonolastic - two-part polysulfide sealant.
 - c. Morton Polymer Systems - Thiokol Sealants.
 - d. Approved Equal.
 - 2. Materials:
 - a. One (1) or two (2) component.
 - b. Meet ASTM C920.

2.02 WATERTIGHT WALL PENETRATION MECHANICAL SEAL

- A. Acceptable Manufacturer:
 - 1. Thunderline Link-Seal.
 - 2. National Pollution Control, Kor-N-Seal.
 - 3. A-Lok.
 - 4. Approved Equal.

- B. Materials:
 - 1. Modular mechanical type, interlocking synthetic rubber links, sized to fill annulus between pipe and wall opening.
 - 2. Rubber links expanded to form watertight seal with Type 304 stainless steel bolts and hardware.
 - 3. Mechanical seals used on fiberglass reinforced plastic (FRP) duct:
 - a. Low durometer type, EPDM expanding rubber.

- C. Fabrication:
 - 1. Cast-in-place anchor and waterstop or core drilled.
 - 2. Size as recommended by the manufacturer.

2.03 WATERTIGHT WALL PENETRATION GASKET SEAL WALL SLEEVE

- A. Acceptable Manufacturer:
 - 1. A-Lok Products Inc., A-Lok Premium Field Sleeve
 - 2. Approved Equal

- B. Materials:
 - 1. Where indicated at Georgetown Regulator, provide gasket seal wall sleeve for pipe-to-structure connection. Sleeve gasket to allow for a maximum loading deflection (out-of-round) of 5 percent and allow for minimum directional rotation of 10 degrees.

- C. Fabrication:
 - 1. Cast with structure.

2. Size as recommended by manufacturer. Provide information including pipe material, outside diameter and structure wall thickness to manufacturer for gasket selection and field sleeve fabrication.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install products in accordance with manufacturer's instructions.
2. Clean all joints.
3. Make all joints water and airtight.
4. Tool sealants using sufficient pressure to fill all voids.
5. Upon completion, leave caulking with smooth, even, neat finish.
6. Where piping, conduit, ductwork, etc., penetrate wall, seal each side of wall opening unless otherwise indicated in the Drawings.

B. Mastic Sealants:

1. Caulk around piping with caulking full length of sleeve.
2. Caulk evenly to outside of sleeve.
3. Follow manufacturer's installation recommendations.
4. Pipe penetrations through walls as indicated in the Drawings.
5. Provide wall escutcheon plates when piping is installed in finished areas or when indicated in the Drawings.

- C. Watertight Wall Mechanical Seal: Install at locations as indicated in the Drawings and at wall penetrations below finish floor elevation and tighten seal as recommended by the manufacturer.

D. Mastic Sealant Schedule:

1. Outdoor areas: Polyurethane.
2. Indoor wet areas: Silicone.
3. Indoor wet, process or chemical corrosive areas: Polysulfide.
4. Submerged areas: Polysulfide.
5. Interior dry, noncorrosive areas: Polyurethane.
6. Fire-rated construction: see Section 07840.

END OF SECTION

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SECTION 15095

PIPING APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies flow and level gages, pressure devices, strainers, sight glasses, vents, quick connect fittings and drains, and spray nozzles.

1.02 QUALITY ASSURANCE (NOT USED)

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Appurtenances shall be located in the piping layout drawings by plant area submitted in accordance with Section 15050.
- C. Manufacturer's product data.
- D. A list of any deviations or substitutions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified or indicated in the Drawings:
 - 1. All equipment shall be the same size as the adjoining pipe.
 - 2. Body material of equipment shall match pipeline material.
 - 3. Pressure rating of equipment shall be no less than 150 PSI.
- B. All units shall have the name of the manufacturer and the size of the unit cast on the body or shown on a permanently attached plate in raised letters.
- C. All equipment provided shall be equipped with flanges, integral unions, or other functional take-a-parts.

2.02 FLOW AND LEVEL GAGES

- A. Rotameters:
 - 1. Purge Rotameters (Seal Water):
 - a. General:
 - 1) Variable area type.
 - 2) Factory assemblies with integral needle valve and flow controller.
 - 3) Range: Seal Water Control Unit rotometers – 0 – 4 gpm.
 - 4) 200 psi working pressure.
 - b. Flow control valve shall be pressure compensated to maintain set flow rate with constant upstream pressure and variable downstream pressure.
 - 1) Materials:
 - a) Meter tube: glass.
 - b) Body and frame: 316 stainless steel.

- 2) Acceptable manufacturers:
 - a) Wallace and Tiernan.
 - b) ITT Conoflow.
 - c) Approved Equal.
 - 2. Rotameters for high-capacity service:
 - a. Glass tube variable area type with 5-inch scale and stainless steel body and frame. Flow range shall be as specified and scales shall indicate the units of flow.
 - b. Acceptable manufacturers:
 - 1) Brooks.
 - 2) Wallace & Tiernan.
 - 3) Schutte & Koerting.
 - 4) Approved Equal.
- B. Sight Gages:
 - 1. Type and material: automatic water gage complete with Pyrex gage glass and gage glass protector.
 - 2. Overall length of gages, type of mounting, and orientation of set shall be as indicated.
 - 3. Acceptable manufacturers:
 - a. 3/4-inch Penberthy.
 - b. Lunkenheimer.
 - c. Approved Equal.
- C. Flow Indicators:
 - 1. Flow indicators shall be provided where indicated.
 - 2. Fabrication: bronze body with threaded ends and a sight glass with rotary wheel.
 - 3. Pressure ratings for flow indicators shall match pipe pressure ratings.
 - 4. Acceptable manufacturers:
 - a. Jacoby-Tarbox.
 - b. Schutte & Koerting.
 - c. Eugene Ernst Products.
 - d. Approved Equal.

2.03 PRESSURE DEVICES

- A. Gage Cocks:
 - 1. The exposed threads of each gage cock shall be protected by a brass plug.
 - 2. Unless otherwise indicated, acceptable manufacturers:
 - a. Robertshaw.
 - b. Ashcroft.
 - c. Approved Equal.
- B. Pressure Gages:
 - 1. Unless otherwise indicated, pressure gage scales shall be selected so that the normal operating pressure falls between 50 and 80 percent of full scale.
 - 2. Diameter: 4-1/2 inch.
 - 3. Movement: 270 degrees.
 - 4. Accuracy: 0.5 percent.
 - 5. Case: non-metallic case with a 1/2-inch NPT bottom connection.
 - 6. Type: premium grade, heavy duty Type 316 stainless steel bourdon tube units with plastic bushings and pinion, and stainless steel sector. Internal pulsation dampening system consisting of either a glycerin fill or a silicone fluid fill; snubbers or orifices are not acceptable.
 - 7. All gauges shall be vertically oriented.
 - 8. Bleed-off valves shall be bronze gage cocks pressure rated for 150 psi.
 - 9. Acceptable manufacturers:
 - a. Ashcroft.
 - b. Ametek.

- c. Approved Equal.
- C. Diaphragm Seals:
- 1. Type 1:
 - a. Body and diaphragm material: Type 316 or Type 316L stainless steel.
 - b. Flushing connection: 1/4-inch.
 - c. Process connection: 1/2-inch.
 - d. Unless otherwise indicated, fill fluid shall be Silicone DC200.
 - e. Acceptable manufacturers:
 - 1) Ashcroft.
 - 2) Ametek.
 - 3) Approved Equal.
 - 2. Type 2:
 - a. Type: flexible sleeve type.
 - b. Size: 1-inch, unless otherwise indicated.
 - c. Unless otherwise indicated, sleeve shall be Buna-N.
 - d. Acceptable manufacturers:
 - 1) Red Valve Series.
 - 2) Ashcroft.
 - 3) Approved Equal.
- D. Flexible Sleeve Pressure Sensors:
- 1. Type: in-line full stream captive sensing liquid type.
 - 2. Materials:
 - a. Wetted parts: 316 stainless steel.
 - b. Sleeve: Buna-N, unless otherwise indicated.
 - c. Capillary tubing: armored stainless steel.
 - 3. Seals:
 - a. Rated for 200 psi with 5-inch SC hysteresis.
 - b. Acceptable manufacturer:
 - 1) Ronningen-Petter.
 - 2) Red Valve.
 - 3) Approved Equal.
 - 4. Fill fluid shall be rated for a temperature range of -20 degrees F to 200 degrees F.
 - 5. Vacuum filling: Fittings shall be provided for vacuum filling of system. Systems that are not factory filled shall be vacuum filled in the field. Filling connections shall be soldered shut after vacuum evacuation and filling.

2.04 STRAINERS

- A. Air and Gas Strainers:
- 1. Unless otherwise indicated, air and gas line strainers shall be Y-pattern with 40 mesh Monel screens packed with Everdur wool.
 - 2. Bronze bodies shall be provided with copper piping. Cast iron bodies shall be provided with steel piping.
 - 3. Air line strainers shall be fitted with a brass blow-off ball valve.
 - 4. Acceptable manufacturers:
 - a. Mueller.
 - b. Armstrong.
 - c. Approved Equal.
- B. Water Strainers:
- 1. Unless otherwise indicated, water strainers shall be Y-pattern.
 - 2. Bronze bodies shall be provided with copper piping. Cast iron bodies shall be provided with steel piping.
 - 3. Strainers shall have 304 stainless steel screens and tapped and plugged blowoff connections.

4. Screen perforations shall be 0.045 inch.
5. Acceptable manufacturers:
 - a. Mueller.
 - b. Armstrong.
 - c. Approved Equal.

C. Fuel Oil Strainers:

1. Fuel oil strainers shall be of the basket type and shall have cast iron body with 304 stainless steel screens.
2. Screen perforation shall be 3/64 inch.
3. Acceptable manufacturers:
 - a. Bailey.
 - b. Mueller.
 - c. Approved Equal.

D. Chemical Strainer:

1. Strainer shall be of the basket type and have a CPVC body and Viton-A O-rings.
2. Screen perforations shall be 1/8 inch.
3. Strainer shall have flanged end connections and strainer cover shall be removable without the use of tools.
4. Acceptable manufacturers:
 - a. Hayward Plastics Products.
 - b. Amiad Filtration Systems.
 - c. Approved Equal.

2.05 QUICK CONNECT FITTINGS

A. Air and water utility station quick connect fittings: Section 15200.

B. All other quick connect fittings:

1. Type: Coupler type, with cam arms. Capable of connecting to a hose adapter without the use of tools.
2. Size: The same size as the pipeline.
3. Materials: PVDF with Teflon gaskets.
4. Acceptable manufacturers:
 - a. Kamlock.
 - b. Chicago Pneumatic.
 - c. Approved Equal.

2.06 SPRAY NOZZLES

A. Flat Pattern Spray Head:

1. Type: Flat fan spray pattern, spray angle 95 degrees at 40 psig.
2. Flow Rate Capacity at 40 psi: 4 gpm.
3. Orifice Diameter: 0.153 inch.
4. End Connection: 3/8-inch, male NPT.
5. Material: Type 303 stainless steel.
6. Provide each with an adjustable ball fitting, stainless steel, 3/8-inch NPT inlet, supplied by nozzle manufacturer.
7. Acceptable Manufacturers:
 - a. Spraying Systems Co.; H3/8U-SS9540 Flat Jet.
 - b. BETE.
 - c. Approved Equal.

PART 3 EXECUTION

3.01 GAGE TAPS

- A. Provide gage taps on the suction and discharge of pumps, fans, compressors, vacuum pumps and blowers.
- B. Gage taps shall consist of a 1/2-inch ball valve attached by a threaded nipple to the pipeline, duct or equipment.

3.02 VENTS AND DRAINS

- A. Vents:
 - 1. Provide manual air vents at the high points of each reach of pipeline indicated in the drawings, and provide additional manual drains as required and specified by the Project Representative after completion of piping installation.
 - 2. Air vents shall be 1-inch and shall consist of full port ball valve and copper tubing return.
 - 3. Air vents shall be taken to the nearest floor with ball valve mounted 4 feet above the floor.
 - 4. Fit vents in piping systems for fluids containing solids with quick couplers.
- B. Drains:
 - 1. Pipe each drain to a sump, gutter, floor drain or other collection point with a valve mounted 4 feet above the floor. Minimum drain size is 1-inch. Install 2-inch drain on piping 4-inch and larger.
 - 2. Drain valves in piping systems for fluids containing solids shall be threaded end full port plug valves of the size specified, fitted with quick couplers. All other drain valves shall be threaded end gate valves of the size specified, fitted with quick couplers.
 - 3. When a drain cannot be run to a collection point, route the drain to a point of easy access and install a valve, of the type and size specified, fitted with a male threaded nipple suitable for connection to a hose.

3.03 FLEXIBLE SLEEVE PRESSURE SENSORS

- A. If system has not been factory filled, vacuum fill the system in the field. Solder filling connections shut after vacuum evacuation and filling.

END OF SECTION

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SECTION 15096

PIPE HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies hangers and supports for all piping systems specified in Section 15050.
- B. This Section does not include pipe supports for fire sprinkler systems, pipe anchors, guides or seismic restraints.
- C. Pipe anchors and pipe guides for pipe expansion control are specified in Section 15090.
- D. Seismic restraints for piping are specified in Section 15097.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
MSS SP-58	Pipe Hangers and Supports – Materials, Design, Manufacturer, Selection, Application, and Installation.
MFMA-4	Metal Framing Manufacturer's Association
AISC M325	American institute of Steel Construction: Manual of Steel Construction

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Integrate all submittals for this Section with Sections 15050, 15090, 15096, and 15097, and submit as part of submittal requirements in Section 15050.
- C. Manufacturer's catalog data on pipe supports and components including data on load capacity.
- D. Hanger and support locations and components indicated on the piping layout drawings prepared, stamped, dated, and signed by the Design Professional per Section 15050.
- E. Fabrication drawings for fabricated components.

1.04 OPERATING CONDITIONS

- A. The hangers and supports specified in this Section are provided to resist pipe vertical and horizontal gravity and seismic loads.
- B. 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:
 - 1. Hot Systems:
 - a. 120 degrees F to 450 degrees F.
 - b. 451 degrees F to 750 degrees F.

- c. Over 750 degrees F.
 - 2. Ambient Systems:
 - a. 60 degrees F to 119 degrees F.
 - 3. Cold Systems:
 - a. 33 degrees F to 59 degrees F.
 - b. 20 degrees F to 32 degrees F.
- C. For the purpose of material selection, spaces are classified as:
- 1. Dry Service Environment including offices, pipe galleries.
 - 2. Wet/Corrosive Service Environment including Wetwells, Pump Rooms, Odor Control Spaces, Chemical storage, storage and handling, battery rooms.

1.05 HANGER AND SUPPORT SELECTION

- A. The contractor shall be responsible for design, select, locate, and provide pipe hanger and supports, pipe guides, in conjunction with design of seismic restraints and expansion control systems by the Design Professional selected in accordance with Section 15050.
- B. Select pipe hangers and supports as specified. Selections shall be based upon the pipe support classifications specified in this Section and the piping insulation thickness specified in Section 15260 and any special requirements which may be specified. Materials will be based on the service environment.
- C. Review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the support to be used at each hanger point. Avoid conflicts with equipment, equipment access, and operation and maintenance access.
- D. Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to the following conditions:
 - 1. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
 - 2. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.
 - 3. Reaction forces due to the operation of safety or relief valves.
 - 4. Wind, snow, or ice loadings on outdoor piping.
 - 5. Reaction forces due to operation conditions and test conditions.
 - 6. Supports shall be designed to prevent transfer of pipe support loads to pipe connections on equipment.
- E. Insure hangers and supports are sized to fit the outside diameter of pipe, tubing, or, where specified, the outside diameter of insulation.
- F. Use rod hangers where negligible pipe movement occurs and for suspended lines, wherever practical. Use bases, brackets or structural cross for piping supported from below.
- G. Hangers for the suspension of 2-1/2 inches and larger pipe and tubing shall be capable of vertical hanger component adjustment under load.
- H. The supporting systems shall provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.
- I. Where there is horizontal movement at a suspended type hanger location, hanger components shall allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.

- J. There shall be no contact between a pipe and hanger or support component of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by use of copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.
- K. Unless otherwise indicated, existing pipes and supports shall not be used to support new piping.
- L. Unless otherwise indicated, pipe support components shall not be attached to pressure vessels.
- M. Stock hanger and support components shall be used wherever practical and be compatible with any existing hanger hardware for system standardization.
- N. Pipe supports for FRP ductwork shall meet the requirements of Section 13234.

1.06 WARRANTY

- A. For the work of this Section, provide warranties as described in the General Conditions, Section 00700, Subsection 7.9B, and provide normal commercial warranties available as described in the General Conditions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Pipe supports shall conform to the requirements of MSS SP-58.
- B. Metal framing system components shall conform to the Metal Framing Manufacturer's Association standard MFMA-4.
- C. For system compatibility, support clips and attachments shall be compatible with Unistrut or B-Line
- D. Acceptable manufacturers:
 - 1. B-Line.
 - 2. Unistrut.
 - 3. Approved Equal.

2.02 MATERIALS

- A. General: Pipe hangers, supports, structural attachments, fittings, and accessories shall be 12 gauge minimum carbon steel, Type 316 stainless steel, or fiberglass as specified in the following table. Area exposure designations are defined and scheduled in Section 01450.

Pipe Support Materials		
Area (Exposure Type)	Pipe Hangers, Supports, Structural Attachments, fittings, and Accessories	Nuts, Bolts, Washers, and Fasteners
Indoor, Dry	Steel, hot dip galvanized after fabrication	Zinc plated steel
Indoor, Wet and Outdoor	Steel, hot dip galvanized after fabrication	Steel, hot dip galvanized after fabrication
Submerged	Type 316 stainless steel	Type 316 stainless steel
Head Space	Type 316 stainless steel or fiberglass (FRP)	Type 316 stainless steel
Chemical Corrosive	Fiberglass (FRP)	Type 316 stainless steel
Process Corrosive	Type 316 stainless steel or fiberglass (FRP)	Type 316 stainless steel

- B. Pipe Hangers and Supports:
1. Type 1 - Clevis Pipe Hanger: configuration and components equivalent to MSS Type 1.
 - a. Steel pipe (uninsulated):
 - 1) B-Line B3100.
 - 2) Anvil Fig. 260.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) Clevis pipe hanger shall be as described in this Section, with insulation shield.
 - c. Cast and ductile iron pipe:
 - 1) B-Line B3102.
 - 2) Anvil Fig. 590.
 - 3) Approved Equal.
 - d. Copper pipe (uninsulated):
 - 1) B-Line B3104 CT.
 - 2) Anvil Fig. CT-65.
 - 3) Approved Equal.
 - e. Copper pipe (insulated).
 - 1) Clevis pipe hanger shall be as described in this Section, with insulation shield.
 - f. Plastic pipe:
 - 1) B-Line B3100 C.
 - 2) Carpenter & Patterson Fig. 100PVC.
 - 3) Approved Equal.
 2. Type 2 - "J" Pipe Hanger: configuration and components equivalent to MSS Type 5. This hanger shall be used only on uninsulated pipe.
 - a. Steel pipe: (uninsulated):
 - 1) B-Line B3690.
 - 2) Anvil Fig. 67.
 - 3) Michigan model 418.
 - 4) Approved Equal.
 - b. Copper and plastic pipe:
 - 1) Michigan model 419.
 - 2) Unistrut J 1205N series.
 - 3) Approved Equal.
 3. Type 3 - Double Bolt Pipe Clamp: configuration and components equivalent to MSS Type 3.
 - a. Steel pipe (uninsulated):
 - 1) B-Line B3144.
 - 2) Anvil Fig. 295.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) Double bolt pipe clamp shall be as described in this Section, with insulation shield. Insulation shield is optional for hot and ambient systems.
 - c. Copper pipe (insulated only):
 - 1) Double bolt pipe clamp shall be as described in this Section, with insulation shield.
 4. Type 4 - Adjustable Roller Hanger: Rollers shall be cast iron or type 304 or 316 stainless steel. Configuration and components shall be equivalent to MSS Type 43
 - a. Steel pipe (uninsulated):
 - 1) B-Line B3110.
 - 2) Anvil Fig. 181.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) Adjustable roller hanger shall be as described in this Section, with insulation shield.
 - c. Copper pipe (insulated only):
 - 1) Adjustable roller hanger shall be as described in this Section, with insulation shield.
 - d. Plastic pipe:
 - 1) B-Line B3110.
 - 2) Anvil Fig. 181.

- 3) Approved Equal.
- 5. Type 5 - Single Pipe Roll: Rollers and sockets shall be cast iron or type 304 or 316 stainless steel. Configuration and components shall be equivalent to MSS Type 41.
 - a. Steel pipe (uninsulated):
 - 1) B-Line B3114.
 - 2) Anvil Fig. 171.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) Single pipe roll shall be as described in this Section, with insulation shield.
 - c. Plastic pipe:
 - 1) B-Line B3114.
 - 2) Anvil Fig. 171.
 - 3) Approved Equal.

6. Type 6 - Framing Channel Pipe Clamp:

- a. Steel pipe (uninsulated):
 - 1) Material thickness:

Pipe size	Material thickness
3/8 inch and 1/2 inch	16 gage
3/4 inch through 1-1/4 inches	14 gage
1-1/2 inches through 3 inches	12 gage
3-1/2 inches through 5 inches	11 gage
6 inches and 8 inches	10 gage

- 2) Acceptable manufacturer:
 - a) Michigan model 431.
 - b) Powerstrut PS 1100.
 - c) Unistrut P 1109 series.
 - d) Approved Equal.
- b. Steel pipe (insulated):
 - 1) Pipe clamp shall be as described in this Section with insulation shield.
- c. Copper (uninsulated) and plastic pipe:
 - 1) Material thickness:

Pipe size	Material thickness
3/8 inch and 1 inch	16 gage
1-1/4 inches and 1-1/2 inches	14 gage
2 inches through 3 inches	12 gage
4 inches	11 gage

- 2) Clamp shall be copper-plated, plastic coated or lined with dielectric material.
- 3) Acceptable manufacturers:
 - a) Michigan model 432.
 - b) Powerstrut PS 1200.
 - c) Unistrut P 2024C and P 2024PC series.
 - d) Approved Equal.
- d. Copper pipe (insulated):
 - 1) Pipe clamp shall be as described in this Section with insulation shield.
- 7. Type 7 - U-Bolt: configuration equivalent to MSS Type 24.
 - a. Steel pipe (uninsulated):
 - 1) Anvil Fig. 137.
 - 2) B-Line B3188.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) U-bolt shall be as described in this Section with insulation shield.
 - c. Cast and ductile iron pipe:
 - 1) anvil Fig. 137.
 - 2) B-Line B3188.

- 3) Approved Equal.
 - d. Copper pipe (uninsulated):
 - 1) Carpenter & Patterson Fig. 222 CT.
 - 2) B-Line B3501 CT.
 - 3) Anvil Fig. 137C.
 - 4) Approved Equal.
 - e. Copper pipe (insulated):
 - 1) U-bolt shall be as described in this Section with insulation shield.
 - f. Plastic pipe:
 - 1) Anvil Fig. 137C.
 - 2) Michigan model 151.
 - 3) B-Line B3188 C.
 - 4) Approved Equal.
8. Type 8 - Adjustable Pipe Roll Support: Rollers and sockets shall be cast iron or type 304 or 316 stainless steel.
- a. Steel pipe (uninsulated):
 - 1) B-Line B3122.
 - 2) Anvil Fig. 177.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) Adjustable pipe roll support shall be as described in this Section with insulation shield.
 - c. Copper pipe (insulated only):
 - 1) Adjustable pipe roll support shall be as described in this Section with insulation shield.
 - d. Plastic pipe:
 - 1) B-Line B3122.
 - 2) Anvil Fig. 177.
 - 3) Approved Equal.
9. Type 9 - Welded Pipe Stanchion: Use of this support shall be limited to ambient systems only.
10. Type 10 - Pipe Stanchion Saddle: comply with MSS Type 37.
- a. Steel pipe (uninsulated):
 - 1) Carpenter & Patterson Fig. 125.
 - 2) B-Line B3090.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) Pipe stanchion saddle shall be as described in this Section with insulation shield.
 - c. Cast and ductile iron pipe:
 - 1) Carpenter & Patterson Fig. 125.
 - 2) B-Line B3090 NS.
 - 3) Approved Equal.
 - d. Copper pipe (uninsulated):
 - 1) Pipe stanchion saddle shall be as described in this Section with insulation shield or lined with dielectric material.
 - e. Copper pipe (insulated):
 - 1) Pipe stanchion saddle shall be as described in this Section with insulation shield.
 - f. Plastic pipe:
 - 1) Carpenter & Patterson Fig. 125.
 - 2) B-Line B3090.
 - 3) Approved Equal.
11. Type 11 – Offset Pipe Clamp: configuration and components as specified. Shall be of standard design manufactured by a pipe hanger component manufacturer.
- a. Steel pipe (uninsulated):
 - 1) B-Line B3148.
 - 2) Anvil Fig. 103.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) Offset pipe clamp shall be as described in this Section, with insulation shield.

- c. Cast and ductile iron pipe:
 - 1) B-Line B3148 NS.
 - 2) Anvil Fig. 103.
 - 3) Approved Equal.
 - d. Copper pipe (insulated):
 - 1) Offset pipe clamp shall be as described in this Section, with insulation shield.
 - e. Copper pipe (uninsulated):
 - 1) Offset pipe clamp shall be as described in this Section, lined with dielectric material.
 - f. Plastic pipe - shall be B-Line B3148, Grinnell Fig. 103, or equal.
 - 1) B-Line B3148.
 - 2) Anvil Fig. 103.
 - 3) Approved Equal.
 - g. Vertical pipe support applications shall be as specified above except that insulation shields shall not be used for insulated pipe.
12. Type 12 - Riser Clamp: configuration and components equivalent to MSS Type 8.
- a. Steel pipe (insulated):
 - 1) B-Line B3373.
 - 2) Anvil Fig. 261.
 - 3) Approved Equal.
 - b. Steel pipe (uninsulated):
 - 1) B-Line B3373.
 - 2) Anvil Fig. 261.
 - 3) Approved Equal.
 - c. Cast and ductile iron pipe:
 - 1) B-Line B3373.
 - 2) Anvil Fig. 261.
 - 3) Approved Equal.
 - d. Copper pipe (insulated):
 - 1) B-Line B3373 CT.
 - 2) Anvil Fig. CT-121.
 - 3) Michigan model 511.
 - 4) Approved Equal.
 - e. Copper pipe (uninsulated):
 - 1) B-Line B3373 CT.
 - 2) Anvil Fig. CT-121.
 - 3) Michigan model 511.
 - 4) Approved Equal.
 - f. Plastic pipe:
 - 1) B-Line B3373.
 - 2) Anvil Fig. 261c.
 - 3) Approved Equal.
13. Type 13 - Framing Channel Pipe Strap: with configuration equivalent to MSS Type 26.
- a. Steel pipe (uninsulated):
 - 1) Superstrut No. C-708-U.
 - 2) Powerstrut PS 3126.
 - 3) Approved Equal.
 - b. Steel pipe (insulated):
 - 1) Framing channel pipe strap shall be as described in this Section with insulation shield.
 - c. Copper pipe (uninsulated):
 - 1) Framing channel pipe strap shall be as described in this Section with insulation shield or lined with dielectric material.
 - d. Copper pipe (insulated):
 - 1) Framing channel pipe strap shall be as described in this Section with insulation shield.
 - e. Plastic pipe:
 - 1) Superstrut No. C-708-U.
 - 2) Powerstrut PS 3126.

- 3) Approved Equal.
- 14. Type 14 – Bridge Clevis: with configuration equivalent to MSS Type 14. Use for hot system only.
 - a. Acceptable manufacturers:
 - 1) Anvil Fig. 299.
 - 2) Approved Equal.
- 15. Type 15 – Turnbuckle: Turnbuckle shall comply with MSS Type 13.
 - a. Acceptable manufacturers:
 - 1) Anvil Fig. 230.
 - 2) B-Line B3202.
 - 3) Approved Equal.
- 16. Type 16 – See Type 3.
- 17. Type 17 – Bridge Clevis shall be as described in Type 14, where used on insulated pipes.
- 18. Type 18 – Double Pipe Straps Clamps: for pipe size 14 inches to 30 inches. Two gussets on each side of the bottom strap with the same thickness as strap.

C. Rack and Trapeze Supports:

- 1. General: Unless otherwise indicated, trapeze and pipe rack components shall have a minimum thickness of 12 gage, or a minimum fiberglass thickness of 0.200 inch, with a maximum deflection 1/240 of the span.
- 2. Type 20 - Trapeze Pipe Support: Trapeze pipe support cross members shall be framing channel, or fiberglass where specified, as specified in this Section. Flat plate fittings shall be 1-5/8 inch square of standard design manufactured by framing channel manufacturer.
 - a. Acceptable manufacturer:
 - 1) Unistrut P2471.
 - 2) B-Line B202-2.
 - 3) Aickinstrut 2000 series.
 - 4) Approved Equal.
- 3. Type 22 - Pipe Rack Supports: Post and cross members shall be framing channel as specified in this Section. Ninety-degree fittings shall be gusseted. Post base fittings shall be as specified in this Section.
 - a. Acceptable manufacturer:
 - 1) Unistrut P2484.
 - 2) B-Line B844.
 - 3) Approved Equal.

D. Structural Attachments:

- 1. Type A - Malleable Iron Concrete Insert: Concrete inserts shall be malleable iron and comply with MSS Type 18.
 - a. Acceptable manufacturers:
 - 1) Anvil Fig. 282.
 - 2) Carpenter & Patterson Fig. 108.
 - 3) Approved Equal.
- 2. Type B - Side Beam Bracket: comply with MSS Type 34.
 - a. Acceptable manufacturers:
 - 1) Anvil Fig. 202.
 - 2) B-Line B3062.
 - 3) Approved Equal.
- 3. Type C - Malleable Beam Clamp with Extension Piece: Beam clamp shall comply with MSS Type 30.
 - a. Acceptable manufacturers:
 - 1) Anvil Fig. 218 with Fig. 157 extension piece.
 - 2) B-Line B3054.
 - 3) Approved Equal.

4. Type D - Beam Clamp with Eye Nut: Configuration and components shall comply with MSS Type 28.
 - a. Acceptable manufacturers:
 - 1) Anvil Fig. 292.
 - 2) Carpenter & Patterson Fig. 297.
 - 3) Approved Equal.
5. Type E - Framing Channel Post Base:
 - a. Single channels:
 - 1) Unistrut P 2072A.
 - 2) B-Line B280.
 - 3) Approved Equal.
 - b. Double channels:
 - 1) Unistrut P 2073A.
 - 2) B-Line B281.
 - 3) Approved Equal.
6. Type F - Welded Beam Attachment: comply with MSS Type 22.
 - a. Acceptable manufacturer:
 - 1) B-Line B3083.
 - 2) Anvil Fig. 66.
 - 3) Approved Equal.
7. Type G - Welded Bracket:
 - a. Medium welded bracket shall comply with MSS Type 32.
 - b. Heavy welded bracket shall comply with MSS Type 33.
8. Type H - Cast Iron Bracket: Bracket shall be cast iron.
 - a. Acceptable manufacturers:
 - 1) Carpenter & Patterson Fig. 340.
 - 2) Anvil.
 - 3) Approved Equal.
9. Type J - Adjustable Beam Attachment:
 - a. Acceptable manufacturers:
 - 1) Carpenter & Patterson Fig. 151.
 - 2) B-Line B3082.
 - 3) Approved Equal.
10. Type K - Double Channel Bracket:
 - a. Wall channel shall be single framing channel, as specified in this Section.
 - b. Cantilever bracket shall be a double framing channel assembly.
 - 1) Acceptable manufacturers:
 - a) Unistrut P2542 through P2546.
 - b) B-Line B297-12 through B297-36.
 - c) Aickinstrut 2000 series.
 - d) Approved Equal.
11. Type L - Single Channel Bracket:
 - a. Wall channel shall be single framing channel, as specified in this Section.
 - b. Cantilever bracket shall be a single framing channel assembly.
 - 1) Acceptable manufacturers:
 - a) Unistrut P2231 through P2234.
 - b) B-Line B198-6, B198-12, B196-18 and B196-24.
 - c) Aickinstrut 2000 series.
 - d) Approved Equal.
12. Type M - Wall Mounted Channel: Wall channel shall be single framing channel, as specified in this Section.
13. Type N - Pipe Stanchion Floor Attachment: Anchor bolt holes shall be 1/16 inch larger than the anchor bolt diameter. The space between the baseplate and the floor shall be filled with non-shrink grout.
14. Type P – Ceiling Structure Attachment: Anchor bolt holes shall be 1/16 inch larger than the anchor bolt diameter.

- a. Acceptable manufacturers:
 - 1) B-line B3084.
 - 2) Anvil.
 - 3) Approved Equal.
 - 15. Type R – Steel Beam Bracket
 - a. For Outdoor and Indoor Dry Environment.
 - b. Carbon steel beams, plates, and anchor bolts as shown in the Drawings.
 - 16. Type S – Steel Pipe Support Floor Attachment
 - a. For Outdoor and Indoor Dry Environment.
 - b. Carbon steel plates and anchor bolts as shown in the Drawings.
 - 17. Type T – Steel Pipe Support Wall Bracket
 - a. For Outdoor and Indoor Dry Environment.
 - b. Carbon steel plates and anchor bolts as shown in the Drawings.
- E. Accessories:
- 1. Hanger Rods: Rods shall be threaded on both ends or continuous threaded and sized as specified.
 - 2. Weldless Eye Nut: Eye nut shall comply with MSS Type 17.
 - a. Acceptable manufacturers:
 - 1) Anvil Fig. 290.
 - 2) B-Line B3200.
 - 3) Approved Equal.
 - 3. Welded Eye Rod: Eye rod shall be with eye welded closed. Inside diameter of eye shall accommodate a bolt diameter 1/8 inch larger than the rod diameter.
 - a. Acceptable manufacturers:
 - 1) Anvil Fig. 278.
 - 2) B-Line B3211.
 - 3) Approved Equal.
 - 4. Framing Channel:
 - a. Framing channel shall be 1-5/8 inches square, roll formed. Channel shall have a continuous slot along one side with in-turned clamping ridges.
 - 1) Single channel:
 - a) Unistrut P 1000.
 - b) B-Line B22.
 - c) Approved Equal.
 - 2) Double channel:
 - a) Unistrut P 1001.
 - b) B-Line B22A.
 - c) Approved Equal.
 - 3) Triple channel:
 - a) Unistrut P 1004A.
 - b) B-Line B22X.
 - c) Approved Equal.
 - b. Embedded concrete insert framing channel shall be 1-5/8 inch wide by 1-3/8 inch deep. Provide end caps or end anchors as recommended by the manufacturer.
 - 1) Embedded concrete insert framing channel:
 - a) Unistrut P 3200 series.
 - b) B-Line B32I series.
 - c) Approved Equal.
 - 2) End caps or end anchors:
 - a) Unistrut P 3280 or P 3704.
 - b) B-Line B206 or B3332.
 - c) Approved Equal.

- c. Fiberglass Framing Channel: Framing channel shall be 1-5/8 inches square, pultrusion formed, fiberglass reinforced plastic with 0.200-inch wall thickness. Channel shall have a continuous slot along one side with in-turned clamping ridges, as manufactured by Aickin Corporation, Aickinstrut 2000 series or approved equal.

2.03 THERMAL PIPE HANGER SHIELD

- A. General:
 1. Thermal shields shall be provided at hanger, support and guide locations on pipe requiring insulation.
 2. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer.
 3. The thermal shield shall be the same thickness as the piping system insulation specified in Section 15260.
 4. The standard shield shall be used for hot systems and the vapor barrier shield shall be used for cold systems.
 5. Stainless steel band clamps shall be used where specified to ensure against slippage between the pipe wall and the thermal shield.
- B. Standard Shield:
 1. Insulation:
 - a. Hydrous calcium silicate, high density, waterproof
 - b. Compressive strength: 100 psi average.
 - c. Flexural strength: 75 psi average.
 - d. K factor: 0.38 at 100 degrees F mean.
 - e. Temperature range: 20 degrees F to 500 degrees F
 2. Steel Jacket: Galvanized steel. Gage shall be the manufacturer's standard supplied for the given pipe size.
 3. Connection: Shield shall have butt connection to pipe insulation. Steel jacket and insulation shall be flush with end.
- C. Vapor Barrier Shield:
 1. Insulation:
 - a. Hydrous calcium silicate, high density, waterproof.
 - b. Compressive strength: 100 psi average.
 - c. Flexural strength: 75 psi average.
 - d. K factor: 0.38 at 100 degrees F mean.
 - e. Temperature range: 20 degrees F to 500 degrees F.
 2. Steel Jacket: Galvanized steel. Gage shall be the manufacturer's standard supplied for the given pipe size.
 3. Connection: Shield shall have butt connection to pipe insulation. Insulation shall extend 1 inch each side of steel jacket for vapor-tight connection to pipe insulation vapor barrier.

PART 3 EXECUTION

3.01 HANGER AND SUPPORT LOCATIONS

- A. Install structural attachments for pipe hangers to beams, structural framing, girders, or embedded framing channel. Structural attachments for pipe hangers in roof decking are not acceptable without review and written approval by the Project Representative.
- B. Pipe hangers hung below elevated slabs shall be installed at regular intervals not exceeding 6 feet, when structural attachments for pipe hangers are set in the slab between beams (hung between beams, structural framing, girders, or embedded framing channel).

- C. Locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc. Locate hangers, supports and accessories within the maximum span lengths indicated in the Drawings to support continuous pipeline runs unaffected by concentrated loads.
- D. Locate at least one hanger or support within 2 feet from a pipe change in direction.
- E. For any valve 6 inches in size and greater, locate at least one hanger or support within 2 feet in either direction of the valve.
- F. Locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.
- G. Where piping is connected to equipment, a valve, piping assembly, etc., which will require removal for maintenance, the piping shall be supported in such a manner that temporary supports are not necessary for this procedure.
- H. Pipe shall not have pockets formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.
- I. Pipe supports for FRP ductwork shall meet the requirements of Section 13234.
- J. Support spacing shall not exceed 6 feet for HDPE pipe. Support spacing shall not exceed 12 feet for all other piping unless otherwise authorized by the Project Representative's review of the proposed deviation noted in the Contractor's piping layout drawing submittal.
- K. The contractor's pipe support system shall not interfere with the function of pipe system flexibility and expansion components or features.
- L. Precast walls cannot be used to support pipe.
- M. Pipe and cable tray supports shall not obstruct operation and maintenance access to equipment, valves, and other appurtenances.
- N. Except as otherwise directed by the Project Representative, loads imposed on structures from Contractor-designed supports for pipe, ductwork, cable trays and conduits, and associated appurtenances shall conform to the following table. In some instances, greater loads may be applied to beams and girders. Consult the Project Representative to ascertain the maximum allowable point load in circumstances where the proposed load would exceed the values in the following table.

	Foundation, Slab on Grade	Elevated Floor Beams (steel or concrete) and Concrete Slabs	Roof Beams (steel or concrete) and Concrete Slabs
Pipe, cable tray, and conduit loads ¹ , maximum, pounds/square foot	100	40	20
Load at structural attachment, maximum, structural attachments at 6-foot centers, pounds	10,000	1,400	700
Load at structural attachment, maximum, structural attachments at 12-foot centers, pounds	10,000	3,000	2,000

¹ Uniform loads based on design allowance for pipe, cable tray, and conduit loads.

- O. Moments applied to walls and columns from cantilevered pipe supports and cable tray shall not exceed 1000 foot pounds per lineal foot of wall or column.

- P. Maximum allowable pipe and cable tray loads applied to walls and columns shall not exceed 200 pounds per lineal foot of wall or column.
- Q. All pump suction piping and equipment connections less than 6 feet above the floor or local grade shall be provided with stanchion-type supports.
- R. Pipe supports shall not span across building expansion joints.

3.02 INSTALLATION

- A. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of AISC M325. Unless otherwise indicated, do not drill or burn holes in the building structural steel.
- B. Do not use hanger components for purposes other than that for which they were designed. Do not use them 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 instead of concrete inserts for support installations in areas below water surface or areas normally subject to submerging.
- E. Install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Make butt joint connections to pipe insulation at the time of insulation installation in accordance with the manufacturer's recommendations.
- F. Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.
- G. Rollers shall roll freely without binding.
- H. Prior to grouting, rough finished floor beneath Type N structural attachments and framing channel post bases. Grout between base plate and floor shall be free of voids and foreign material.
- I. Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.
- J. Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 7 feet above the floor, walkways, mezzanines, and other locations requiring operator access.
- K. Seal all cut ends of fiberglass framing channels in accordance with manufacturer instructions.

3.03 ADJUSTMENTS

- A. Adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Adjust stanchions prior to grouting their baseplates.

3.04 ANCHOR BOLTS

- A. Anchor bolt material and installation requirements shall conform to Section 05501.
- B. Anchor bolts shall not be in contact with reinforcing steel.

3.05 FIELD PAINTING

- A. Field painting pipe hangers and supports shall conform to Section 09900.

END OF SECTION

SECTION 15097

SEISMIC RESTRAINTS FOR PIPING

PART 1 SUMMARY

- A. This Section specifies seismic restraints for bracing all piping systems specified in Section 15050 and all FRP odor ducts specified in Section 13234. This Section does not include seismic restraints for fire sprinkler systems.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ANSI A58.1	Minimum Design Loads for Buildings and Other Structures
AISC Manual of Steel	American Institute of Steel Construction, Manual of Steel Construction, Allowable Stress Design
MFMA-4	Metal Framing Standards Publication
MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation.
SMACNA, PPIC	Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems
FM Global Data Sheet 1-11	Fire following Earthquakes

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's catalog data on pipe attachments, restraints, braces, fittings and accessories including load capacities. Drawings showing location and type of seismic bracing to be installed.
- C. For each seismic restraint location, provide calculations substantiating the loads, in all directions, that the seismic restraint system shall withstand. Calculations shall be stamped, dated, and signed by the Design Professional registered in the state of Washington, and per Section 15050.
- D. A legend (to the piping layout drawings required by Section 15050 that gives load information and restraint component selection at each restraint location.
- E. Fabrication drawings for fabricated seismic restraints components.
- F. Integrate all submittals for this Section with Sections 15050, 15090, 15096, and 15097, and submit as part of submittal requirements in Section 15050.

1.04 DEFINITIONS

- A. Longitudinal direction--direction parallel to the pipe axis.
- B. Lateral direction--direction perpendicular to the pipe axis.

1.05 OPERATING CONDITIONS

- A. The seismic restraints specified in this Section are provided to resist pipe movements and loads occurring as a result of an earthquake or other seismic event in accordance with the Drawings.
- B. Unless otherwise specified, all piping shall have bracing to resist seismic loading caused by forces applied at the individual pipe's center of gravity. Seismic loading shall be as specified in Section 01031.

1.06 RESTRAINT SELECTION

- A. The contractor shall be responsible for design of seismic restraints for piping in conjunction with preparation of the design of pipe hangers and supports and of expansion control systems by the Design Professional selected in accordance with Section 15050.
- B. Unless otherwise specified, select, locate and provide seismic restraints for piping.
- C. 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.
- D. Seismic restraints may be omitted from the following installations:
 - 1. Gas piping less than 1-inch inside diameter.
 - 2. Piping in boiler and mechanical rooms less than 1 1/4-inch inside diameter.
 - 3. All other piping less than 2 1/2-inch inside diameter.
 - 4. All piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the support for the hanger.
- E. Piping systems shall not be braced 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.
- F. Restraints shall be sized to fit the outside diameter of the pipe, tubing, or, where specified, the outside diameter of insulation.
- G. There shall be no 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.
- H. Branch lines shall not be used to brace main lines.
- I. Seismic bracing shall not limit the expansion and contraction of the piping system.

1.07 WARRANTY

- A. For the work of this Section, provide warranties as described in the General Conditions, Section 00700, Subsection 7.9B, and provide normal commercial warranties available as described in the General Conditions.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 ACCEPTABLE MANUFACTURER

- A. Carpenter & Patterson.
- B. B-Line.
- C. Kin-Line.
- D. Anvil.
- E. Michigan.
- F. Pipe Shields Incorporated.
- G. Superstrut.
- H. Unistrut.
- I. Approved Equal.
- J. Pipe restraint materials shall conform to the requirements of MSS SP-58 and MFMA-4.

2.03 MATERIALS

- A. General: Unless otherwise specified, materials for restraints, including braces, pipe and structural attachments shall be as specified in Section 15096.
- B. Conform to MSS SP-58 and MFMA-4.

2.04 PIPE ATTACHMENTS

- A. Type 1s: Clevis Restraint Attachment:
 - 1. Type 1, clevis pipe hanger, as specified in Section 15096.
- B. Type 3s: Double Bolt Restraint Clamp:
 - 1. Type 3, double bolt pipe clamp, as specified in Section 15096.
- C. Type 4s: Roller Restraint Attachment:
 - 1. Type 4, adjustable roller hanger, as specified in Section 15096
 - 2. Hold down strap shall be sized as follows:

Pipe size (in.)	Hold down strap (in.)	Hold down strap thickness (in.)
1 to 2	1	1/8
2-1/2 to 4	1-1/4	3/16
6	2	3/16
8	2 1/12	3/16
10 to 16	2 1/12	1/4
20	3	1/4
24	3	3/8

- D. Type 7s: U-Bolt Restraint: Type 7, U-bolt, as specified in Section 15096.
- E. Type 13s: Framing Channel Strap Restraint: Type 13, framing channel pipe strap, as specified in Section 15096.

- F. Type 14s: Pipe Clamp Restraint: configuration and components equivalent to MSS Type 4. Rod attachment and longitudinal brace connection stud shall be fabricated and welded by the manufacturer.
 - 1. Steel pipe (uninsulated):
 - a. Superstrut No. S-720.
 - b. Kin-Line No. S475.
 - c. Approved Equal.
 - 2. Steel pipe (insulated):
 - a. Pipe clamp restraint shall be as described in this Section with insulation shield.
 - 3. Cast and ductile iron pipe:
 - a. Pipe clamp restraint shall be as described in this Section.
 - 4. Copper pipe (insulated):
 - a. Pipe clamp restraint shall be as described in this Section, with insulation shield.
 - 5. Copper pipe (uninsulated):
 - a. Pipe clamp restraint shall be as described in this Section, with insulation shield or dielectric lining.
 - 6. Plastic pipe:
 - a. Pipe clamp restraint shall be as described in this Section.

- G. Type 20s: Single Channel Lateral Restraint:
 - 1. Cross member shall be 1-5/8 inch square framing channel.
 - 2. Acceptable manufacturers:
 - a. Unistrut P1000.
 - b. B-Line B22.
 - c. Superstrut A-1200.
 - d. Approved Equal.
 - 3. Pipe attachments shall be Type 13s or Type 7s specified in this Section.
 - 4. Rod stiffeners and lateral brace shall be as specified in this Section.

- H. Type 21s: Double Channel Lateral Restraint:
 - 1. Cross member shall be a double channel manufactured assembly.
 - 2. Acceptable manufacturers:
 - a. Unistrut P1001.
 - b. B-Line B22A.
 - c. Superstrut A-1202.
 - d. Approved Equal.
 - 3. Pipe attachments shall be Type 13s or Type 7s specified in this Section.
 - 4. Rod stiffeners and lateral brace shall be as specified in this Section.

- I. Type 22s: Double Channel Lateral Restraint:
 - 1. Cross member shall be a double channel manufactured assembly.
 - 2. Acceptable manufacturers:
 - a. Unistrut P1001.
 - b. B-Line B22A.
 - c. Superstrut A-1202.
 - d. Approved Equal.
 - 3. Pipe attachments shall be Type 13s or Type 7s specified in this Section.
 - 4. Rod stiffeners, longitudinal and lateral braces shall be as specified in this Section.

2.05 TRAPEZE RESTRAINTS

- A. General: Unless otherwise indicated, trapeze members shall have a minimum thickness of 12 gage, with a maximum deflection 1/240 of the span.

- B. Type 20s: Single Channel Lateral Restraint:
 - 1. Cross member shall be 1-5/8 inch square framing channel.

2. Acceptable manufacturer:
 - a. Unistrut P1000.
 - b. B-Line B22.
 - c. Superstrut A-1200.
 - d. Approved Equal.
 3. Pipe attachments shall be Type 13s or Type 7s specified in this Section.
 4. Rod stiffeners and lateral brace shall be as specified in this Section.
- C. Type 21s: Double Channel Lateral Restraint:
1. Cross member shall be double channel manufactured assembly.
 2. Acceptable manufacturer:
 - a. Unistrut P1001.
 - b. B-Line B22A.
 - c. Superstrut A-1202.
 - d. Approved Equal.
 3. Pipe attachments shall be Type 13s or Type 7s specified in this Section.
 4. Rod stiffeners and lateral brace shall be as specified in this Section.
- D. Type 22s: Double Channel Longitudinal Restraint:
1. Cross member shall be a double channel manufactured assembly.
 2. Acceptable manufacturer:
 - a. Unistrut P1001.
 - b. B-Line B22A.
 - c. Superstrut A-1202.
 - d. Approved Equal.
 3. Pipe attachments shall be Type 13s or Type 7s specified in this Section.
 4. Rod stiffeners, longitudinal and lateral braces shall be as specified in this Section.

2.06 BRACES AND FITTINGS

- A. SEISMIC BRACE FITTING:
1. Manufactured for use with industry standard framing channel.
 2. Welded construction, two-piece linked fitting.
 3. Provide a means to reduce noise and vibration transmission between the linked fitting parts.
 4. Acceptable manufacturer:
 - a. Superstrut C-749N series seismic brace.
 - b. Kin-Line No. 633 seismic connector fitting.
 - c. Approved Equal.
- B. Hanger Rod Stiffener Assembly:
1. Rod stiffener channel shall be 1-5/8 inch square framing channel.
 2. Rod stiffener channel shall be:
 - a. Unistrut P1000.
 - b. B-Line B-22.
 - c. Superstrut A-1200.
 - d. Approved Equal.
 3. Rod stiffener clamps shall be complete with channel nut.
 4. Rod stiffener clamps shall be:
 - a. Superstrut ES-142.
 - b. Kin-Line No. 635.
 - c. Approved Equal.
- C. Type A1 Seismic Brace:
1. Shall be 1-5/8 inch square framing channel.
 2. Acceptable manufacturer:
 - a. Unistrut P1000.

- b. B-Line B22.
 - c. Superstrut A-1200.
 - d. Kin-Line No. 4112.
 - e. Approved Equal.
- D. Type A2 Seismic Brace:
- 1. Shall be 1-5/8 inch wide by 3-1/4 inch deep framing channel.
 - 2. Acceptable manufacturer:
 - a. Unistrut P 5000.
 - b. B-Line B-11.
 - c. Superstrut H-1200.
 - d. Kin-Line No. 8212.
 - e. Approved Equal.

2.07 STRUCTURAL ATTACHMENTS

- A. General:
- 1. Unless otherwise indicated, hanger rod structural attachments shall be as specified in Section 15096.
 - 2. Structural attachments for longitudinal and lateral seismic braces shall be as specified in Section 15096.
- B. Type SA-1 Attachment:
- 1. Brace fitting shall be as specified in this Section.
 - 2. Concrete anchors shall be as specified in Section 05501 with embedment and location dimensions as specified.
- C. Type SA-2 Attachment:
- 1. Brace fitting shall be as specified in this Section.
 - 2. Concrete anchors shall be as specified in Section 05501 with embedment and location dimensions as specified.
 - 3. Framing channel shall be as specified in this Section.
- D. Type SA-3 Attachment:
- 1. Brace fitting shall be as specified in this Section.
 - 2. Cap screw, lockwasher and hex nut materials and finish shall be compatible with structural steel material.
- E. Type SA-4 Attachment:
- 1. Brace fitting shall be as specified in this Section.
- F. Type SA-5 Attachment:
- 1. Brace fitting shall be as specified in this Section.
 - 2. Four-inch x 3-inch x 3/8-inch angle.

2.08 ACCESSORIES

- A. Hanger Rods:
- 1. Threaded on both ends or continuous threaded and sized as specified.
- B. Framing Channel:
- 1. Shall conform to MFMA-1 standard.
 - 2. Continuous slot along one side with in-turned clamping ridges.
 - 3. Acceptable manufacturer:
 - a. Unistrut P1000 series.
 - b. B-Line B22 series.

- c. Superstrut A-1200 series.
 - d. Approved Equal.
- C. Rod Coupling:
 - 1. Sight hole in center of coupling body.
 - 2. Acceptable manufacturer:
 - a. Anvil Fig. 135.
 - b. Superstrut H-119.
 - c. Approved Equal.
- D. Thermal Pipe Hanger Shield:
 - 1. Thermal shields shall be provided at seismic restraint locations on pipe requiring insulation. Thermal pipe hanger shields shall be as specified in Section 15096. Stainless steel band clamps shall be provided on thermal shields at longitudinal pipe restraint locations.

2.09 THERMAL PIPE HANGER SHIELD

- A. Thermal shields shall be provided at seismic restraint locations on pipe requiring insulation. Thermal pipe hanger shields shall be as specified in Section 15096. Stainless steel band clamps shall be provided 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 feet from the main riser, from an entrance to a building, or from a piece of equipment.
- B. Brace cast iron pipe on each side of a change in direction of 90 degrees 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 feet and laterally every 10 feet.
- 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 inches of the elbow or tee of the same size.
- E. Seismic restraint locations and components shall be indicated on the piping layout drawings required by Section 15050. Provide a legend giving load information and restraint component selection at each restraint location.
- F. Pipe systems with thermal expansion control anchors shown in the Drawings may utilize those anchors for seismic bracing.
- G. Seismic bracing shall not hinder the functioning of thermal expansion control systems, but shall accommodate expected movement of piping due to temperature changes.

3.02 INSTALLATION

- A. Use rod stiffener assemblies at seismic restraints for hanger rods over 6 inches in length. Use a minimum of two rod stiffener clamps on any rod stiffener assembly.
- B. Install lateral and longitudinal bracing between 45 degrees above and 45 degrees below horizontal, inclusive, relative to the horizontal centerline of the pipe.

- C. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of AISC M011. Do not drill or burn holes in the building structural steel without approval of the Project Representative.
- 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 in accordance with the manufacturer's recommendations.
- F. Restraint components in contact with plastic pipe shall be free of burrs and sharp edges.
- G. Rollers shall 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 feet above the floor, walkways, mezzanines, and other locations requiring operator access.
- I. Install seismic sway bracing on gas piping in accordance with FM Global Data Sheet 1-11. Hangers less than 12 inches long are not an acceptable substitute for bracing.

3.03 FIELD QUALITY CONTROL

- A. The County will provide special inspection in accordance with Section 01031 for certain piping seismic anchorage and bracing systems as indicated in the Drawings.

3.04 TESTING

- A. In addition to any testing herein, perform all testing for this product or system consistent with the requirements of Section 01660, the applicable codes, and the manufacturers' current quality assurance program.

END OF SECTION

SECTION 15101

GATE VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies bronze and iron-body, solid-wedge or double disc gate valves.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
AWWA C500	Metal-Seated Gate Valves for Water Supply Service

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data, catalog cuts, or shop drawings describing construction, dimensions, and materials. Indicate on the submittal the valve tag numbers and each Piping System where the product will be used.
- C. Affidavits of compliance, as required by AWWA C500.
- D. Hydrostatic test results.

1.04 DESIGN CRITERIA

- A. Gate valves 3 inches through 48 inches in size shall comply with AWWA C500, including applicable hydrostatic testing.
- B. Gate valves smaller than 3 inches shall be subject to hydrostatic tests at the test pressure.

PART 2 PRODUCTS

2.01 USAGE

- A. Gate valves shall be used in the following piping systems as specified in PIPESPEC, Section 15050:
 - 1. System 7.
 - 2. System 7A.
 - 3. System 9.
 - 4. System 33.

2.02 ACCEPTABLE MANUFACTURER

- A. Smaller than 3 inches:
 - 1. Nibco.
 - 2. Stockham.
 - 3. Approved Equal.

- B. 3 inches and Larger:
 - 1. Clow (Canada).
 - 2. Mueller.
 - 3. U.S. Pipe Metropolitan.
 - 4. Approved Equal.

2.03 MATERIALS

- A. Materials of construction shall be as follows:

Component	Material
Body	
3 inches and smaller	Bronze
Larger than 3 inches	Cast iron, ASTM A126, Class B
Wedge or Double Disc	
3 inches and smaller	Bronze
Double Disc	
Larger than 3 inches	Cast iron, ASTM A126, Class B
Mounting	Bronze, AWWA C500
Seat rings	Bronze, Grade A, AWWA C500,

2.04 FABRICATION

- A. General:
 - 1. Unless otherwise indicated, bronze gate valves shall be provided with integral seats.
 - 2. Iron body valves:
 - a. Iron body valves shall be provided with screwed-on seat rings.
 - b. Exposed gate valves shall be rising stem type.
 - c. Buried or submerged gate valves shall be of the nonrising stem type.
 - d. Rising stem valves and brass nonrising stem valves shall be provided with a Teflon braid packing.
 - e. Iron body nonrising stem valves shall be provided with O-ring stem seals.

- B. End Connections: Gate valve end connections shall be flanged, mechanical joint, or threaded as specified. Threaded ends shall not be provided on gate valves with end connections larger than 4 inches. End flanges shall be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1 for 125-pound flanges.

- C. Bypass: Unless otherwise indicated, gate valves 16 inches and larger shall be provided with a bypass valve sized in accordance with AWWA C500.

2.05 OPERATORS

- A. Manual operators:
 - 1. See Section 15140.
 - 2. Unless otherwise indicated, valves smaller than 12 inches shall be provided with handwheels, and valves 12 inches and larger shall be provided with geared operators.

- B. Electric or hydraulic valve operators shall be specified in Section 15140.

PART 3 EXECUTION

3.01 GENERAL

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.
- B. Install in the closed position.
- C. Valves included in the City of Seattle waterline work shall be installed according to the City of Seattle Standard Details.
 - 1. Valves installed as part of the Fire Protection System (Symbol FP) shall comply with the requirements of NFPA and Section 15330.

3.02 FIELD QUALITY CONTROL

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.
- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.
- C. Be responsible for all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

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SECTION 15103
BUTTERFLY VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies butterfly valves.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
ANSI B16.5	Pipe Flanges and Flanged Fittings ASTM A48-83 Gray Iron Castings
ASTM A108	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A216/A216M	Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
ASTM A276	Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A436	Austenitic Gray Iron Castings
ASTM A536	Ductile Iron Castings
AWWA C504	Rubber-Seated Butterfly Valves

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Shop drawings, illustrating valve component configuration, dimensions, material specifications (list ASTM designations) with certified leakage test results in accordance with AWWA C504, pressure drop characteristics, and operator torque requirements.
- C. Affidavits of compliance with AWWA C504 for Type A valves.
- D. Control valve operator data as required in Section 15140.
- E. Operation and maintenance information: Section 01730.

1.04 TYPE USAGE (SEE SPECIAL REQUIREMENT IN PIPESPEC, SECTION 15050)

- A. Type A:
1. System 7.
 2. System 7A.
 3. System 13.

PART 2 PRODUCTS

2.01 MATERIALS

A. Type A: Specified according to size as follows.

1. Type A, Size 3 through 24 inches:

Component	Material
Body	Cast iron, ASTM A126, Class B
Shaft	Stainless steel, ASTM A276, Type 316
	Carbon steel, ASTM A108, with stainless steel journals
Disc	Ductile iron, ASTM A536, or cast iron, ASTM A436, type 1 (Ni-Resist); or ASTM A48, Class 40, or ASTM A126, Class B
Seat mating surface	Stainless steel, ASTM A276, Type 316, mounted in body or on disc edge; or Ni-Chrome on the disc edge
Seat sealing surface	Neoprene or Buna N (nitrile); natural rubber

2. Type A, Size 30 through 72 inches:

Component	Material
Body	Cast iron, ASTM A126, Class B
Shaft	Stainless steel, ASTM A276, Type 316
Disc	Ductile iron, ASTM A536, or cast iron, ASTM A48, Class 40
Seat mating surface	Stainless steel, ASTM A276, Type 304, mounted in body or on disc edge
Seat sealing surface	Neoprene or Buna N (nitrile); natural rubber

2.02 FABRICATION

A. General:

1. Valves shall be the stub or through shaft design.
2. Valves shall be flanged.
3. Unless otherwise indicated, valve flange drilling shall be per ANSI B16.1, Class 125.

B. Type A:

1. Designed in accordance with AWWA C504 with class 150B pressure rating.
2. Shafts shall be turned, ground and polished.
3. Shaft dimensions and operator torque shall be chosen for the pressure specified in Section 15050 and Class B as specified in AWWA C504.
4. When carbon steel shafts and stainless steel journals are used, static seals shall be provided to isolate the interior of the disc and the shaft from the process fluid.
5. Valve seats:
 - a. Type A valves, size 3 through 72 inches, shall have valve seats that are vulcanized, bonded, mechanically secured, or clamped to the body or disc.
 - b. Type A valves, size 30 through 72 inches, shall have valve seats that are field adjustable and field replaceable. Discs for valves shall be of the flow-through type with a 360-degree seating design.

2.03 MANUAL OPERATORS

- A. Manual operators:
 - 1. General:
 - a. Comply with applicable portion of Section 15140.
 - b. Manual operators shall be designed in accordance with AWWA C504 and shall have a disc position indicator designating the opened and closed position of the valve.
 - 2. Type A:
 - a. Manual operators for Type A valves shall be of the traveling nut, rack and pinion, or worm gear type.
 - b. Operators shall be equipped with adjustable mechanical stop-limiting devices to prevent overtravel of the disc in the open and closed positions and shall be self-locking and designed to hold the valve in any intermediate position between full open and full closed.
 - c. Valve operator components shall withstand an input torque of 300 ft-lbs at the extreme operator positions without damage.
 - d. Operator for buried service shall include an AWWA operating nut and shall be gasketed and grease packed for submerged operation at water pressures to 10 psig.
 - e. Operators for exposed service shall include a handwheel and be gasketed for weatherproof service.

- B. Electric and hydraulic valve operators shall be as specified in Section 15140.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.

3.02 FIELD QUALITY CONTROL

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.
- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.
- C. Be responsible for all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

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SECTION 15104

BALL VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies ball valves.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following document. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and that of the listed documents, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI B16.1	Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
ASTM A536	Ductile Iron Castings
ASTM A564	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM D1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
AWWA C507	Ball Valves 6 inches through 48 inches.
MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-110	Ball Valves; Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Valve: manufacturer's catalog data and shop drawings with dimensions showing plan view and elevations; cross sectional view showing internal components and materials of fabrication, and component weight.
- C. Operator: manufacturer's catalog data and shop drawings with dimensions showing plan view and elevations; cross sectional view showing internal components and materials of fabrication, and component weight.
- D. Open/close and holding torque calculations used in sizing the actuator.
- E. Factory test results.
- F. Field test results.
- G. Installation and start-up instructions.
- H. Operations and maintenance information: Section 01730.

1.04 FACTORY TESTS FOR VALVES 6 INCHES AND LARGER

- A. Test each valve.
- B. Per AWWA C507.

- C. Cycled six times from the fully open to the fully closed position and vice versa to demonstrate the valve is free from binding, vibration, and chatter. Cycled three times at each of the following full stroke times: 10 seconds and 60 seconds.
- D. With its ball in the open position and both ends bulkheaded, shall be subject to a test pressure of 150 psi. This pressure shall be maintained for period of at least 60 minutes during which time all valve parts shall show no evidence of distress, leaks, or weeping.
- E. With its ball in the closed position and the downstream flange bulkheaded, shall be subject to a test pressure of 150 psi. This pressure shall be maintained for period of at least 30 minutes during which time the valve shall maintain a drop tight seal. Leakage through the valve at 20 psi shall not exceed one half pint per minute.
- F. The Engineer reserves the right to witness the factory testing. Inform the Project Representative and the Engineer at least 30 days prior to the factory tests.

PART 2 PRODUCTS

2.01 METALLIC BALL VALVES, 1/4 TO 4 INCHES DIAMETER

- A. Metallic ball valves shall be used in the following piping systems as specified in PIPESPEC, Section 15050:
 - 1. System 2.
 - 2. System 5.
 - 3. System 7.
 - 4. System 7A.
 - 5. System 9.
 - 6. System 18.
 - 7. System 24.
- B. Comply with MSS SP-72 or MSS SP-110.
- C. Acceptable manufacturers:
 - 1. Apollo.
 - 2. Jamesbury.
 - 3. Watts.
 - 4. Stockham.
 - 5. Nibco.
 - 6. Approved Equal.

D. Materials:

Component	Material
Body	Bronze
Stem, stem gland nut	Brass (water service); stainless steel (sewage, combined sewage, odor control service)
Ball	Brass, chrome plated (water service); stainless steel (sewage, combined sewage, odor control service)
Seats, stuffing box ring, and thrust washer	Reinforced Teflon
Handle	Vinyl coated or zinc- or cadmium-plated steel

- E. Design requirements:
1. Rated for 400 psi and 250 degrees F, WOG for threaded end applications and 285 psi WOG and 150 psi saturated steam service for flanged end applications.
 2. Handles showing direction of opening.
 3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.
 4. Stem with reinforced Teflon stuffing box ring and blowout-proof design.
 5. Renewable reinforced Teflon seats.
 6. Ball design which does not allow media contact with stem.
 7. Balancing stop for all applications.
 8. Bodies with mounting pad for applications requiring actuators.

2.02 PLASTIC BALL VALVES, 1/2 INCHES TO 4 INCHES DIAMETER

- A. Plastic ball valves shall be used in the following piping systems as specified in PIPESPEC, Section 15050:
1. System 19.
 2. System 24A.
 3. System 25.
- B. Acceptable manufacturers:
1. Chemtrol.
 2. Spears.
 3. ASAH/America.
 4. Approved Equal.

C. Materials:

Component	Material
Body, stem, ball, handle, end connectors	PVC, SCH 80, ASTM D1784, Class 12454B, or CPVC, SCH 80, ASTM D1784, Class 23447B
Ball seat	Teflon
O-rings	Viton or PTFE encapsulated fluorocarbon

- D. Design requirements:
1. Rated at 150 psi at 75 degrees F.
 2. Double or "true union" design.
 3. Blocks both directions, upstream and downstream.
 4. Union nut capable of compensating for seat wear.
 5. Body with mounting pad for actuators where required.
 6. Capable of being disconnected at downstream end under full line pressure.
 7. Vented ball (factory drilled on upstream side of valve) with flow arrow clearly marked on valve housing.

2.03 METALLIC BALL VALVES, 6 INCHES DIAMETER AND LARGER

- A. Metallic ball valves shall be used in the following piping systems as specified in PIPESPEC, Section 15050:
1. System 7A.
 2. System 24A.
- B. Acceptable Manufacturer:
1. Henry Pratt Co.
 2. APCO/Willamette.
 3. Approved Equal.

C. Materials:

Component	Material
Body and ball	Ductile iron ASTM A536, grade 65-45-12
Ball Seat	stainless steel Type 304
Body Seat	400 series monel
Bearings	Bronze with dissimilar hardness as per AWWA C507
Shaft	18-8 Type 304 or 17-4 Type 630 stainless steel

D. Design Requirements:

1. General:

- a. Full-ported metal-to-metal seated ball valves with flanged ends, rated at 150 psi and drilled to ANSI B16.1 Class 125.
- b. Single-seated at the inlet opening. No seating surfaces shall be provided at the downstream opening.
- c. Seating and unseating action shall be eccentric with two degrees of offset.
- d. Clear waterways shall be provided between the ball and the body to permit and encourage flushing action as the ball is moved from the open to closed position and vice versa.
- e. Fabrication per AWWA C507 for ball valves 6 through 48 inches with metal seats.
- f. Drop tight and meet or exceed AWWA C507 Section 5 inspections and testing standard.

2. Body:

- a. Flanges: flat faced and machined parallel to each other within 0.005 inch.
- b. A rigid means for supporting the torque unit without the necessity of additional supports.
- c. Provide both a drain and vent hole drilled and tapped.

3. Ball:

- a. Integrally cast bronze bushed trunnions for the operating shaft. One trunnion holds the operating shaft which passes through the packing seal area and connects to the actuator.

E. Seats:

1. Seating surfaces shall be located on the upstream opening of the body and on the upstream face of the ball.
2. Seats shall be of the flexible metal type. Ball and body seats shall be accurately machined and aligned on slightly offset centers to insure that the seating surfaces are in contact only when the ball is at the actual point of closing and do not drag against each other when the ball is cycled.
3. Ball and body seats: rigidly attached to the base metal and accurately machined to form the seating seal. Body seat shall not protrude into the waterway.

F. Bearings:

1. Mating surfaces shall be of dissimilar hardness to prevent galling or binding.
2. Load shall not exceed 2000 psi at 250 psi differential pressure.

G. Shafts:

1. Ball shaft shall be so designed that the factor of safety for all combined stresses shall be at least five to one.
2. Maximum torsional deflection shall not exceed 1/6 degree per foot of unsupported length using a seat coefficient of friction of 0.5 and a bearing coefficient of friction of 0.3.

H. Shaft Seal:

1. Pass through a sealing area equipped with a field-replaceable packing or O-ring seal.
2. The sealing device shall be capable of being removed and having the seal replaced with the line under pressure, without removing the valve from the line.

- I. Finish:
 - 1. All internal cast or ductile iron surfaces, except finished or bearing surfaces, shall be shop painted with corrosion resistant epoxy primer. Coal tar coating products are not acceptable.
 - 2. All exterior surfaces, except finished or bearing surfaces, shall be shop painted with manufacturer's standard corrosion resistant primer.

2.04 CONNECTIONS

- A. Unless otherwise indicated in the Drawings, ball valves 2 inches and smaller shall have true union connections and ball valves larger than 2 inches shall have flange connections.

2.05 OPERATORS

- A. See Section 15140.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.

3.02 FIELD QUALITY CONTROL

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.
- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.
- C. Be responsible for all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

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SECTION 15107
ECCENTRIC PLUG VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies eccentric plug valves.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800
ASME B16.10	Face-to Face and End-to-End Dimensions of Valves
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	Ductile Iron Castings
AWWA C517	Resilient-Seated Cast-Iron Eccentric Plug Valves

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data, catalog cuts, and shop drawings detailing materials of fabrication, assembly, dimensions, weight, Cv value, and flow capacity.
- C. Manufacturer's installation instructions.
- D. Certified proof of design tests per AWWA C517.
- E. Affidavit of Compliance.in accordance to AWWA C517.
- F. Certified drawings for spherical solid passage.
- G. Spare Parts: Section 01750.
- H. Operation and maintenance information: Section 01730.

1.04 CERTIFIED TEST

- A. Provide a certified statement certifying successful completion of proof-of-design testing conducted in accordance with AWWA C517.
- B. Perform proof-of-design testing on at least one valve of each size and class, with all test units demonstrating full compliance with the test standards.
- C. Failure to satisfactorily complete the test shall be deemed sufficient evidence to reject all valves of the proposed make or manufacturer's model number.

PART 2 PRODUCTS

2.01 USAGE

- A. Plug valves shall be used in the following piping systems as specified in PIPESPEC, Section 15050:
1. System 12.
 2. System 13.
 3. System 16.
 4. System 24.
 5. System 24A.
 6. System 24B.

2.02 ACCEPTABLE MANUFACTURERS

- A. Milliken.
- B. Victaulic.
- C. Approved Equal.

2.03 DESIGN REQUIREMENTS

- A. Pressure ratings: Unless otherwise indicated, valves shall, as a minimum, conform to the following:

Valve Size	Working Pressure
12 inches and smaller	175 PSI
14 inches through 36 inches	150 PSI
42 inches through 54 inches	125 PSI

2.04 MATERIALS

Component	Material
Body	Cast iron, ASTM A126, Class B, or ductile iron, ASTM A536
Plug	
3" – 20"	Ductile iron, ASTM A536
24 and larger	Cast iron
Plug facing	Neoprene or Buna-N
Body seats	
3 inches and larger	Welded-in overlay of not less than 90 percent nickel
Packing	Buna or TFE
Bearings	
Less than 20 inches	Permanently lubricated (oil impregnated) stainless steel
24 inches and larger	Permanently lubricated (oil impregnated) bronze
Buried valves	Buried valves shall be epoxy coated for corrosion protection, all flange or mechanical connection bolts and nuts shall be stainless steel 316.

2.05 FABRICATION

- A. General:
1. Straight-flow non-lubricated resilient plug type suitable for drip-tight, bi-directional shutoff at the specified valve design pressure.
 2. Each valve body shall be plainly marked to indicate seat end.

3. Unless otherwise indicated, port areas for valves 20 inches and smaller shall be at least 80 percent of the adjacent full pipe area 100 percent of the adjacent full pipe area for valves larger than 20 inches.
4. Unless otherwise indicated, port areas of valves shall be capable of passing spherical solids which are at least 85 percent of the pipe size for valves 14 inches and smaller and at least 50 percent the pipe size for valves 16 inches and larger.
5. Port area shall be round for valve sizes 14 inches and smaller; rectangular ports are not acceptable. Rectangular ports are acceptable for 16 inches and above.
6. Valve body seats consisting of nickel for valves 3 inches and larger shall be fabricated of a welded-in overlay of not less than 90 percent pure nickel.
7. For valves 20 inches and smaller, upper and lower bearings shall be replaceable sleeve type, permanently lubricated stainless steel. Bronze bearings are not acceptable.
8. For valves 24 inches and larger, upper and lower journal shall be replaceable, sleeve-type, permanently lubricated bronze. Aluminum bronze bearings are not acceptable.
9. Bearings shall be protected at both the top and bottom with PTFE grit seals.
10. Shaft seals shall be self-adjusting chevron type packing, or "U" cup with "O" ring, replaceable without removing the plug.
11. Plug valve manufacturers shall provide certified test results verifying that the minimum Cv values specified below have been met for valves of the same model and size. Large plug valves shall have the following minimum Cv values:

Plug valve size	Cv value (minimum)
8-inch	2,030
12-inch	4,140
14-inch	8,500
24-inch	21,300

- B. End Connections:
 1. Valves 3 inches and smaller: threaded ends.
 2. Valve 4 inches and larger: flanged, ASME B16.1, Class 125.
 3. Grooved-end valves may be provided with grooved-end piping systems.
- C. Lay Length: Flanged valves and grooved end valves equipped with manufacturer's standard flange adapters shall conform to ASME B16.10 Table 1, for short pattern Class 125 cast iron plug valves.
- D. Manual Operators:
 1. Comply with applicable portions of Section 15140.
 2. Gear operator sized for bidirectional shutoff at design pressure in accordance with AWWA C517, Section 3.8.
 3. Where indicated, manual operators shall have an adjustable stop.
- E. Powered Operators: valves requiring powered operators are scheduled in Section 15140.

2.06 SPARE PARTS

- A. Per Section 01750.
- B. Provide rebuild kits for each size valve. The quantity of rebuild kits shall be one minimum or five percent of the total of each size valve installed, rounded up.

PART 3 EXECUTION

3.01 GENERAL

- A. Unless otherwise indicated, install valves with the seat downstream away from flow.

- B. Install valves at tank connections with seat away from tank.
- C. Install valves on pump discharge lines with seat adjacent to the pump.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.

3.03 FIELD QUALITY CONTROL

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.
- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.
- C. Be responsible for all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

SECTION 15110

SPRING-LOADED SWING CHECK VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies spring-loaded swing check valves 3 IN through 6 IN.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless Steel Bars and Shapes
ASTM A536	Ductile Iron Castings
AWWA C508	Swing Check Valves for Waterworks Service

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data detailing materials, construction, dimensions, valve weight, and flow capacity.
- C. Manufacturer's product data detailing limit switch system, materials and wiring diagram.
- D. Operation and maintenance information: Section 01730.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment No.	Valve Name	Size (inches)
CHV854331A	Influent Sample Pump 1 Discharge Check Valve	3
CHV854332A	Influent Sample Pump 2 Discharge Check Valve	3
CHV854331B	Influent Sample Pump 1 C2 Flush Check Valve	3
CHV854332B	Influent Sample Pump 2 C2 Flush Check Valve	3
CHV854301	EQ Basin Drain Pump 1 Discharge Check Valve	6
CHV854302	EQ Basin Drain Pump 2 Discharge Check Valve	6
CHV854505	Effluent Sump Pump 1 Check Valve	3
CHV854611	Solids Return pump 1 Check Valve	6
CHV854612	Solids Return pump 2 Check Valve	6
CHV854966	Fire Sprinkler Check Valve	4

2.02 ACCEPTABLE MANUFACTURERS

- A. APCO.
- B. Approved Equal.

2.03 DESIGN REQUIREMENTS

A. Unless otherwise indicated, valves shall, as a minimum, conform to the following:

Valve Size	Working Pressure	Hydrostatic Test Pressure
3 inches to 6 inches	175 psi	350 psi

2.04 MATERIALS

Component	Material
Body and Cover	Cast Iron ASTM A126, Grade B
Disc arm and disc	Ductile Iron ASTM A536
Seat	Stainless Steel ASTM A276
Disc Seal	Buna N
Cover Gasket	Composition
Shaft	Stainless Steel, Type 303 or 17-4 PH
Hinge Shaft Bearing	Bronze
Seat Pins and Lock Screws	Stainless Steel
Spring Tensioner	Stainless Steel

2.05 FABRICATION

- A. Heavy cast iron body per AWWA C508 with flanged ends, stainless steel seat rings and shaft for attachment of spring.
- B. Provide tapped and plugged drain and vent holes in valve body and cover.
- C. All internal components shall be field replaceable without use of special tools.
- D. Valve Disk:
 - 1. Double clevis mounted to arm.
 - 2. Suspended from non-corrosive shaft extending through both sides of the body.
 - 3. O-ring type shaft seals.

2.06 LIMIT SWITCHES

- A. Valves equipped with limit switches:
 - 1. Designed to determine fully open to fully closed position, securely attached to check valve and lever arm as required to determine position.
 - 2. Mechanism: heavy-duty snap action, over-the center switch contained in a die cast metallic NEMA 4X enclosure with chemical resistant Viton gaskets and seals.
 - 3. Contain one normally open and one normally closed fine silver contact rated NEMA A600, 120 VAC, 10 Amp continuous wiping action operation; replaceable contacts without disconnect of external wiring.
 - 4. Wiring terminals: accommodate #22 - #12 stranded copper wire; identify on permanently attached nameplate.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.
- B. Limit switches shall be wired as specified in Divisions 16 and 17, and indicated in the Instrumentation Drawings.

END OF SECTION

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SECTION 15111

CUSHIONED SWING CHECK VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies cushioned swing check valves, 8 inches and larger.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A276	Stainless Steel Bars and Shapes
ASTM A536	Ductile Iron Castings
AWWA C508	Swing Check Valves for Waterworks Service

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data detailing materials, construction, dimension, weight, and flow capacity.
- C. Manufacturer's product data detailing oil cushioned system, materials and operation system.
- D. Manufacturer's product data detailing limit switch system, materials and wiring diagram.
- E. Operation and maintenance information: Section 01730.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment Number	Valve Name	Size
CHV854531	C3 Pump 1 Check Valve	8
CHV854532	C3 Pump 2 Check Valve	8

2.02 ACCEPTABLE MANUFACTURERS

- A. APCO.
- B. Approved Equal.

2.03 DESIGN REQUIREMENTS

A. Unless otherwise indicated, valves shall, as a minimum, conform to the following:

Valve Size	Working Pressure	Hydrostatic Test Pressure
8 inches to 12 inches	175 PSI	350 PSI
14 inches and larger	150 PSI	300 PSI

2.04 MATERIALS

Component	Material
Body and cover	Cast iron, ASTM A126 Grade B
Disc arm and disc	Ductile Iron, ASTM A536
Seat	Stainless steel, ASTM A276
Disc seat	Metal, to suit
Cover gasket	Composition
Hinge shaft	Stainless steel, Type 303 or Type 17-4 PH
Hinge shaft bearing	Bronze
Cushion chamber	Corrosion resistant metal
Cushion rod	Stainless steel
Seat pins and lock screws	Stainless steel

2.05 FABRICATION

- A. Heavy cast-iron body per AWWA C508 with flanged ends, stainless steel seat ring, non-corrosive shaft for attachment of weights and levers, and complete non-corrosive cushion chamber.
- B. Capable of being field converted to spring-loaded style without the use of special tools.
- C. Provide tapped and plugged flush and drain and vent holes in valve body and cover, respectively.
- D. All internal components shall be field replaceable without the use of special tools and without removal of the valve from the pipeline.
- E. Cushioning for valves 8 inches and larger:
 - 1. Side mounted, fully-enclosed oil-filled cushioning system totally independent from process fluid.
 - 2. Field replaceable without removing valve from the pipeline.
 - 3. Constructed with a piston operating in a chamber that will effectively permit the valve to close without slamming.
 - 4. Designed to permit free open and positive, non-slam controlled closure of the disc. The last 10 percent of closure shall be externally adjustable (both length of stroke and rate of closure) to suit actual operating conditions.
- F. Valve disc:
 - 1. Double clevis mounted to arm.
 - 2. Suspended from a non-corrosive shaft extending through both sides of the body. Shaft seals shall be O-ring type.
 - a. Valves 12 inches and smaller shall have a single lever and adjustable weight. Field convertible to either side without the use of special tools.
 - b. Valves 14 inches and large shall have a lever and adjustable weight mounted on each side.

2.06 LIMIT SWITCHES

- A. Valves shall be equipped with limit switches designed and installed to determine if the valve disc is fully closed and not fully closed. Limit switches shall be heavy-duty, snap action, over-center switch mechanisms contained in a die cast metallic NEMA 4X enclosure with chemical resistant Viton gaskets and seals. Switches shall include one normally-open and one normally-closed fine silver contacts rated NEMA A600, 120 VAC, 10 amp continuous with wiping action operation. Contacts shall be replaceable without disconnecting external wiring. Wiring terminals shall accommodate AWG #22-12 stranded copper wire and shall be identified on a permanently attached nameplate.
- B. Limit switches shall be factory installed securely to the check valve and lever arm as required to determine disc position.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.
- B. Adjustments:
 - 1. Adjust stroke and rate of closure speed of cushioned swing check valves in the field by means of external adjustment devices to achieve quiet non-slam closure and to minimize pressure surges.
 - 2. Adjust location of weights on disc arms to affect proper closing action on equipment shutdown.
- C. Limit switches shall be wired as specified in Divisions 16 and 17, and indicated in the Instrumentation Drawings.

END OF SECTION

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SECTION 15112

DUCKBILL CHECK VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies elastomeric duckbill check valves.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM A126	Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings

1.03 SUBMITTALS

- A. Procedure: Section 01300.
- B. Manufacturer's product data, detailing materials, construction, dimensions, flow and back-pressure capacity.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment Number	Valve Name	Size
V854300B	18" Chemical Drain Backflow	18" dia
V854300A	8" Chemical Drain Backflow	8" dia

2.02 MATERIALS

Component	Material
Valve Body	Cast iron, ASTM A126
Clamps	Stainless steel, Type 316
Flange Ring	Steel
Duckbill Sleeve and Check Tube	Rubber or nylon
Tube Reinforcement	Neoprene or EPDM

2.03 FABRICATION

- A. General:
- Port areas:
 - 100 percent of the mated pipe port area.
 - Contour to a duckbill, allowing passage in one direction of flow and preventing reverse flow within specified operating and backflow pressures.
 - Flanges, flange or backup rings and flexible sleeves: Drilled to ANSI B16.1, Class 150.
 - Company name and plant location: bonded to the check valve or valve body.

- B. In-line check valves:
 - 1. Housed in a cast-iron body.
 - 2. Check tube: nylon, reinforced with a wrapping of 1/8-inch thick Neoprene.
 - 3. Valve body: drilled and tapped for a flushing connection on top and bottom of the housing.
 - 4. Acceptable manufacturer:
 - a. Red Valve.
 - b. Approved Equal.

- C. Direct-discharge check valve (flanged connection):
 - 1. Provided with a steel flange ring for bolting to flanged pipe.
 - 2. Check tube: nylon, reinforced with 1/8-inch thick Neoprene.
 - 3. Valves specified for exterior: reinforced with fabric and wrapped with EPDM for protection against weathering and ultraviolet attack.
 - 4. Acceptable manufacturer:
 - a. Red Valve.
 - b. Approved Equal.

- D. Direct-discharge check valve (slip-on connection):
 - 1. Provided with 2 stainless steel clamps for attaching the valve to the pipe outside diameter.
 - 2. Check tube: rubber with fabric reinforcement and EPDM wrapping.
 - 3. Acceptable manufacturer:
 - a. Red Valve.
 - b. Approved Equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.

3.02 FIELD QUALITY CONTROL

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.
- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.
- C. Be responsible for all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

SECTION 15120

REDUCED PRESSURE PRINCIPLE BACKFLOW PREVENTERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies reduced pressure principle backflow preventers for potable water, irrigation system, and reduced pressure principle detector check backflow preventers for fire control.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revisions to the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
AWWA C511 Seattle Municipal Code 21.04.070	Reduced-Pressure Principle Backflow-Prevention Assembly Cross Connections

- B. Device shall be approved by the Washington State Board of Health.
- C. All devices shall be the products of one manufacturer.
- D. Device shall be approved by Seattle Public Utilities.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data detailing materials, construction, dimensions, flow capacity, and pressure loss curves.
- C. Manufacturer's installation instructions.
- D. Current certificates:
1. Backflow preventer: Washington State Board of Health approval.
2. Backflow Assembly Tester: Washington State and local authority.
- E. Backflow preventers enclosure fabrication shop drawings with materials data, as indicated in the Drawings and specified in this Section.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment Number	Valve Name	Size, inches
RPBP854964	City Water RPBP	6
RPBP854965	Irrigation System RPBP	2
RPBP854966	Fire Protection RPBP	6

2.02 ACCEPTABLE MANUFACTURERS

- A. Backflow Preventer
 - 1. 2-inch and smaller:
 - a. Watts.
 - b. Febco.
 - c. Approved Equal.
 - 2. 2 1/2-inches and larger:
 - a. Cla-Val.
 - b. Febco.
 - c. Watts.
 - d. Approved Equal.
 - 3. Confirm backflow preventer meets requirements of Seattle Public Utilities.

- B. Enclosure:
 - 1. Hubbell (Hot Box).
 - 2. Watts.
 - 3. Approved Equal.

2.03 BACKFLOW PREVENTER

- A. Reduced pressure principle device consisting of two independently operating spring loaded check valves and one hydraulically dependent differential relief valve.

- B. All internal parts shall be serviceable without removing the valve body from the line. Side serviceable products will not be accepted.

- C. Rated to 175 psi working pressure and water temperature range from 32 to 140 degrees F.

- D. Materials:

Component	Material
2-inches and smaller	
Body	Bronze
Springs	Stainless steel
Isolation valves	Full port ball-type, threaded ends
2 1/2-inches and larger	
Body	Epoxy-coated cast iron
Springs	Stainless steel
Isolation valves	OSY isolation valves, flanged or grooved ends

- E. Equip with manufacturer's standard air gap drain.

- F. Test cocks:
 - 1. Accessible from the front (room side) of the device.
 - 2. Point up, down, or to the front.
 - 3. Pointing to the rear (wall side) or to the side are not permitted; provide elbows or tubes between the device body and the test cocks.
 - 4. Ball valves shall be oriented such that their handles or screwdriver slots are visible and readily accessible from the front or top of the device.
 - 5. Equip test cocks with resilient-seated test equipment adapters and permanently attached protective caps.
 - 6. Acceptable manufacturer:
 - a. Watts TC.
 - b. Approved Equal.

2.04 ENCLOSURE

- A. Aluminum, sectional removable doors.
- B. Insulated to provide a minimum R-value of 10.
- C. Heated:
 - 1. Self regulated heating cables.
 - 2. 120V, 1 phase, 1000W-2000W.
 - 3. Number of heaters and size as required by Manufacturer.
- D. Continuous hinge.
- E. Hasp for padlock.
- F. Color selected by Project Representative.
- G. Sized to enclose equipment and meet minimum clearances per Drawings and manufacturer's recommendations.
- H. Screened drain to daylight shall be sized for full port backflow discharge.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Backflow preventer:
 - 1. Install in accordance with manufacturer's instructions and as indicated in the Drawings.
 - 2. Install in accordance with Seattle Public Utilities requirements.
 - 3. Install horizontally with relief valve discharging vertically downward. Maintain air gap with drain pipe.
 - 4. Install with adequate space above and below for servicing and rebuilding.
 - 5. Install service platform as required by code when centerline of unit is greater than 4 feet above the floor. Submit shop drawings for the platform, stairs, railings as required; platform shall not interfere with through traffic or be a tripping hazard; construct of galvanized or FRP materials.
- B. Enclosure:
 - 1. Provide where indicated in the Drawings.
 - 2. Mount to concrete pad.

3.02 FIELD QUALITY CONTROL

- A. Performed by Backflow Assembly Tester certified in the state of Washington and the local authority.
- B. Witnessed by the Project Representative and, if required, the local authority having jurisdiction.
- C. Submit two copies of the test report and the tester's certification, and provide equipment tracking numbers for these valves.

END OF SECTION

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SECTION 15121

PRESSURE REGULATING VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies pressure regulating valves for air, water, and gas service.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI B16.5	Steel Pipe Flanges, Flanged Valves and Fittings

- B. Performance:
1. Direct-acting type pressure-regulating valves shall control the discharge pressure within +/-5 percent of set pressure.
 2. Pilot-controlled type pressure-regulating valves shall maintain the set discharge pressure regardless of fluctuations in inlet pressure.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data detailing materials, construction, dimensions, weight, flow capacity, and head loss curves.
- C. Hydrostatic test results.
- D. Operations and maintenance information: Section 01730.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

- A. Pressure regulating valves are scheduled here.

Valve number	Service	Valve size, inches	Maximum flow	Inlet pressure range psi (b)	Regulated outlet pressure/initial setting, psi
RV854261	IA	1/2	30 cfm	90-100	40
RV854343	C2	1 1/2	45 gpm	90	60
RV854355A	C2	4	100 gpm	100	90
RV854362	IA	1/2	30 cfm	90-100	40
RV854363	IA	1/2	30 cfm	90-100	40
RV854364	IA	1/2	30 cfm	90-100	40
RV854365	IA	1/2	30 cfm	90-100	40
RV854366	IA	1/2	30 cfm	90-100	40
RV854451B	C2	1/2	4 gpm	90	50

Valve number	Service	Valve size, inches	Maximum flow	Inlet pressure range psi (b)	Regulated outlet pressure/initial setting, psi
RV854562	IA	1/2	30 cfm	90-100	40
RV854563	IA	1/2	200 cfm	90-100	40
RV854564	IA	1/2	200 cfm	90-100	40
RV854566	C2	3/4	10 gpm	90	50
RV854568	SA	2	30 cfm	90-100	90
RV854961	SA	1	200 cfm	90-100	40
RV854375	NG	3/4	60 mbh	2	14 IN W.C.
RV854971	NG	1	375 mbh	2	14 IN W.C.
RV854374	NG	1 1/4	617 mbh	2	14 IN W.C.
RV854377	NG	3/4	60 mbh	2	14 IN W.C.
RV854978	NG	3/4	105 mbh	2	14 IN W.C.
RV854574	NG	1	390 mbh	2	14 IN W.C.
RV854430	C2	1	28 gpm	90	50
RV854431	C2	1	28 gpm	90	50
RV854504	SA	2	25 cfm	90-100	10
RV854551B	C2	1 1/2	36 gpm	90	50
RV854964	C1	6	1800 gpm Min flow: 15 gpm	110-130	100
RV854434	C2	1	40 gpm	90	50
RV854435A	C2	1	40 gpm	90	50
RV854435B	C2	1	40 gpm	90	50
RV854435C	C2	1	40 gpm	90	50
RV854435D	C2	1	40 gpm	90	50
RV854435E	C2	1	40 gpm	90	50
RV854560	C2	1	40 gpm	90	50

2.02 GENERAL

- A. Flanged or threaded connections, as specified.
- B. For moving parts requiring lubrication, provide means for such, and lubricate prior to delivery.

2.03 DESIGN REQUIREMENTS

- A. Water Service Valves:
 - 1. Valves 2 inches and smaller:
 - a. Direct-acting, spring-operated type.
 - b. Provide upstream strainers in accordance with Section 15095.
 - c. Acceptable manufacturers:
 - 1) Wilkins.
 - 2) Mueller.
 - 3) Approved Equal.
 - 2. Valves 2 1/2 inches and larger:
 - a. Unless otherwise indicated, pilot-controlled type.
 - b. Strainers for the pilot system: May be located in the pilot piping or integral to regulating valve body.
 - c. Acceptable manufacturers:
 - 1) Cla-Val.
 - 2) Bailey.
 - 3) Approved Equal.

- B. Air Service Valves:
 - 1. Provide upstream strainers in accordance with Section 15095.
 - 2. Acceptable manufacturers:
 - a. Bailey.
 - b. Cash-Acme.
 - c. Approved Equal.

- C. Gas Service Valves:
 - 1. AGA approved.
 - 2. Provide upstream strainers in accordance with Section 15095.
 - 3. Sized as recommended by the manufacturer for the intended use.
 - 4. Acceptable manufacturers:
 - a. Fisher.
 - b. Kieley and Mueller.
 - c. Approved Equal.

PART 3 EXECUTION

3.01 GENERAL

- A. Install valves in accordance with manufacturer's instructions and as indicated in the Drawings.
- B. Install take-aparts on both ends of the pressure reducing valves and the strainers.

3.02 TESTING

- A. Hydrostatic tests shall be conducted by the manufacturer for one valve of each type supplied for a particular service.
- B. Hydrostatic test steel-bodied valves in accordance with the requirements of ANSI B16.5.
- C. Hydrostatic test aluminum-, bronze-, and brass-bodied valves at double the maximum pressure specified.
- D. Leakage, sweating, or visible deformation at any point on the valve shall be cause for rejection of valves of that type and manufacturer.
- E. The Engineer reserves the right to witness the factory testing. Inform the Project Representative and the Engineer at least 30 days prior to the factory tests.

END OF SECTION

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SECTION 15123

PRESSURE RELIEF VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies pressure relief valves.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ASME SEC VIII	Boiler and Pressure Vessel Code, Pressure Relief Devices

- B. ASME certified and rated.
- C. Equipped with test lever and ASME stamp tag.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Catalog information to show compliance with this Section. Indicate the tank or pressure vessel being protected by the relief valve(s).
- C. Size and capacity calculations and information.
- D. Operation and maintenance information: Section 01730.

PART 2 PRODUCTS

2.01 PRESSURE RELIEF VALVES FOR AIR SERVICE

- A. Non-adjustable, factory set at pressure required for the system by the manufacturer.
- B. Bronze body, stainless steel wetted parts.
- C. Capacity/size: Per ASME Section VIII and local codes and in accordance with the pressure vessel and the valve manufacturer's recommendations.
- D. Acceptable manufacturers:
 1. Kunkle.
 2. Conbraco.
 3. Approved Equal.

2.02 PRESSURE RELIEF VALVE FOR HYDROPNEUMATIC TANK

- A. Non-adjustable, factory set at pressure as required for the system by the manufacturer.
- B. Bronze body, stainless steel wetted parts.
- C. Capacity/size:
 - 1. Hydropneumatic tank: 3.0 times the pumping capacity of a single water pump at 290 feet of head.
 - 2. In no case less than 3/4-inch pipe size.
- D. Acceptable manufacturers:
 - 1. Kunkle.
 - 2. Conbraco.
 - 3. Approved Equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions, the local plumbing code and as indicated in the Drawings.

END OF SECTION

SECTION 15124
SOLENOID VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies 2- and 3-way solenoid valves, direct or pilot operated type, for control of process fluids.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM A48	Gray Iron Castings
UL 429	Electrically Operated Valves
UL 1002	Electrically Operated Valves for Use in Hazardous Locations, Class I, Groups A, B, C, and D, and Class II, Groups E, F, and G

- B. Valves shall be listed by Underwriters Laboratories Inc. in accordance with UL 429 and UL 1002.
- C. Solenoid valves for gas service shall be approved by Factory Mutual Engineering Corporation.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data, catalog cutsheets, detailing of material, construction, and capacity information.
- C. Manufacturer's certificates of compliance with the specified standards.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

- A. See Sections 15130 and 15135.

2.02 ACCEPTABLE MANUFACTURERS

- A. Direct Acting Type:
 - 1. Automatic Switch Company.
 - 2. Honeywell-Skinner.
 - 3. Approved Equal.

- B. Pilot Type:
 1. Cla-Val Co.
 2. Golden Anderson.
 3. Approved Equal.

2.03 DESIGN REQUIREMENTS

- A. Type:
 1. Valves with piping connections less than 1-1/2 inches in diameter shall be direct-acting type.
 2. Valves with piping connections 1-1/2 inches in diameter and greater shall be pilot operated globe body type.
- B. Unless otherwise specified, solenoid valves shall be designed to seal the pressurized (supply) port upon de-energization.
- C. The minimum acceptable operating pressure differential for pilot operated valves shall be 5 psi.

2.04 MATERIALS

- A. Direct Acting Type: Materials of construction shall be as follows:

Component	Material
Body	Brass or stainless steel, Type 304
Seal	Teflon or Buna-N
Disc	Teflon or Buna-N

- B. Pilot Type: Materials of construction shall be as follows:

Component	Material
Main valve body	Cast iron, ASTM A48
Pilot control body	Brass

2.05 FABRICATION

- A. General: Unless otherwise indicated, solenoid valves shall be rated for continuous duty at 120 volts AC. Valves shall be threaded for sizes 2-inch and smaller and flanged for sizes 2-1/2 inch and larger.
- B. Direct Acting Type: Valves shall have combination NEMA 7C, 7D and 4 enclosures. Solenoids shall have fully encapsulated Class H coils.
- C. Pilot Type: Valves shall have combination NEMA 7 and 9 enclosures. Solenoids shall have molded, Class F coils. Pilot control shall be adjustable to regulate the rate of opening and closing the main valve over a range of 5 to 230 seconds.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.

3.02 FIELD QUALITY CONTROL

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.

- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.
- C. Be responsible for all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

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SECTION 15130

SEAL WATER CONTROL UNIT SCHEDULE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section contains the schedule of the control units for this work. Control units shall be supplied to control the flow of seal water to pumps and other specified devices.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ISA-S75.02	Standard Control Valve Capacity Test Procedure

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. A layout drawing of the control units.
- C. A materials list.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

- A. The following table contains the schedule of control units.

Control unit type ^a	Solenoid valve numbers	Solenoid valve size	Solenoid valve Position ^b	Supply piping to control unit	CU and supply piping to equipment	PCV/PRV setting (psi)	Rotometer/controller flow range initial setting (gpm)	Equipment served	Control unit usage
B	SV854311	½"	NC	¾"	¼"	56 psi	2 gpm	Train 1 Influent Pump 1	Seal Water Control Unit Panel 1
B	SV854312	½"	NC	¾"	¼"	56 psi	2 gpm	Train 1 Influent Pump 2	Seal Water Control Unit Panel 1

Control unit type ^a	Solenoid valve numbers	Solenoid valve size	Solenoid valve Position ^b	Supply piping to control unit	CU and supply piping to equipment	PCV/PRV setting (psi)	Rotometer/controller flow range initial setting (gpm)	Equipment served	Control unit usage
B	SV854313	1/2"	NC	3/4"	1/4"	56 psi	2 gpm	Train 1 Influent Pump 3	Seal Water Control Unit Panel 1
B	SV854321	1/2"	NC	3/4"	1/4"	56 psi	2 gpm	Train 2 Influent Pump 1	Seal Water Control Unit Panel 2
B	SV854322	1/2"	NC	3/4"	1/4"	56 psi	2 gpm	Train 2 Influent Pump 2	Seal Water Control Unit Panel 2
B	SV854323	1/2"	NC	3/4"	1/4"	56 psi	2 gpm	Train 2 Influent Pump 3	Seal Water Control Unit Panel 2

^a Control units shall be in accordance with seal water control unit details in the Drawings.

^b Solenoid valve positions: NC = normally closed; NO = normally open.

2.02 VALVE SIZING

- A. Where the specified valve is smaller than the connected pipe, provide reducers.
- B. Pressure drop across each valve for the purpose of actuator sizing shall be the "maximum" pressure for the service as listed on the PIPESPEC sheets in Section 15050.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.

3.02 FIELD QUALITY CONTROL

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.
- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.

- C. Be responsible for all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

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SECTION 15135

CONTROL VALVE SCHEDULES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies schedules of the control valves, solenoid valves and control units for this Work.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ISA-S75.02	Standard Control Valve Capacity Test Procedure

- B. Unit Responsibility:

1. The system shall be the end product of one responsible system manufacturer. The Contractor shall assign unit responsibility to the manufacturer of the valve/gate, actuator, or representative of either corporation. This manufacturer is the Unit Responsibility manufacturer and has unit responsibility for the actuators in Section 15140, the valves or gates in applicable sections as required by Section 15135. Agents, representatives, or other entities who are not a direct component of the manufacturing corporation can provide the Unit Responsibility.
2. The Unit Responsible manufacturer shall ensure coordination of design and selection of all system components such that all valves/gates and actuators provided as part of the Unit Responsibility is compatible and operates reliably and properly to achieve the performance requirements specified. Unit responsibility for related components in an assembly does not require or obligate the Unit Responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them.
3. The Contractor shall coordinate valve/gate and actuator selection with the Unit Responsible manufacturer and shall be responsible for providing the equipment as specified herein. Contractor shall assure that all valve/gate and actuator components provided as part of the system are the products for which Unit Responsibility has been coordinated by the Unit Responsible manufacturer in this Section.
4. The requirement for Unit Responsibility shall in no way relieve the Contractor of responsibility for performance as specified in the Contract Provisions.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Product Data.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

- A. Butterfly Valves (Section 15103):

Control valve number	Service	Line size ¹ inches	Operator Type ¹	Positioner ²	Open/close time ^{3,4} , seconds	Unpowered Position ⁵	Operator Service Type ⁶
BTV854304	C3	6	Type 1	I	30	NC	O/C
BTV854305	C3	6	Type 1	I	30	NC	O/C
BTV854306	C3	6	Type 1	I	30	NC	O/C
BTV854307	C3	6	Type 1	I	30	NC	O/C
BTV854519	C3	8	Type 1	I	30	NC	O/C
BTV854529	C3	8	Type 1	I	30	NC	O/C
BTV854621	C3	6	Type 1	I	30	NC	O/C
BTV854622	C3	6	Type 1	I	30	NC	O/C
BTV854623	C3	6	Type 1	I	30	NC	O/C
BTV854624	C3	6	Type 1	I	30	NC	O/C

1. Operator Type as per Section 15140.
2. Positioner:
 - a. NC: Normally closed.
 - b. NO: Normally open.
 - c. I: Intermediate (maintains valve position during failure).
3. Adjust, initial setting as listed, minimum stroke time in accordance with Section 15140.
4. Unique open and close initial time settings as listed.
5. Unpowered Position:
 - a. AS: As shown.
 - b. NC: Normally closed incoming supply port.
 - c. NO: Normally open.
6. Operator Service Type:
 - a. M: Modulating.
 - b. O/C: Open/Closed.
 - c. T: Throttling.

B. Solenoid Valves (Section 15124) Other Than in Seal Water Control Units:

Valve number	Service	Line size, inches	Valve size, inches	Operating pressure, psig, maximum	Operating temperature, degrees F, maximum	Unpowered position ¹
SV854451	C2	1/2	1/2	100	70	NC
SV854453	C2	1/2	1/2	100	70	NC

1. Unpowered Position:
 - a. NC: Normally closed.
 - b. NO: Normally opened.

2.02 VALVE SIZING

- A. Where the specific valve is smaller than the connected pipe, provide reducers. Pressure drop across each valve for the purpose of actuator sizing shall be the "maximum" pressure for the service as listed on the PIPESPEC sheets in Section 15050. Cv values shall be as determined by ISI-SA 75.02.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.

3.02 FIELD QUALITY CONTROL

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.
- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.
- C. Be responsible for all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

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SECTION 15140

VALVE AND GATE OPERATORS AND OPERATORS APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies manual, hydraulic, and powered operators for valves and gates, and operator appurtenances.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM A519	Seamless Carbon and Alloy-Steel Mechanical Tubing
ASTM B584	Copper-Alloy Sand Castings for General Applications
AWWA C500	Standard for Gate Valves 3 Inches Through 48 Inches NPS for Water and Sewage Systems
AWWA C541	Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates
AWWA C542	Electric Motor Actuators for Valves and Slide Gates
AWWA C561	Fabricated Stainless Steel Slide Gates
AWWA C563	Fabricated Composite Slide Gates
JIC P-1	Pneumatic Standards for Industrial Equipment and General Purpose Machine Tools
NEMA ICS	Industrial Control Devices, Controller and Assemblies
ASME B1.5	ACME Screw Threads

- B. Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Affidavits of compliance, as required by AWWA C500 and C542.
- C. Manufacturer's product data detailing materials, construction, and dimensions.
- D. Electric motor or hydraulic operator data, where applicable, including manufacturer's catalog information, complete dimensional data, drive unit size, Wiring and control diagrams.
- E. Valve operating torque and torque capacity of the submitted operators.
- F. Operations and maintenance manuals: Section 01730.
- G. Spare parts: Section 01750.

1.04 SPECIAL WARRANTY FOR HYDRAULIC OPERATORS

- A. Reference Section 01740.
- B. Ten year extended warranty beginning at the date of Substantial Completion.

PART 2 PRODUCTS

2.01 OPERATORS

- A. General:
 - 1. Factory-mounted on the valve or gate and provided as a unit.
 - 2. Valve body or operator shall have cast thereon the word OPEN, an arrow indicating the direction of rotation to open, and flow direction arrows.
 - 3. Sized to produce 150 percent of the maximum required valve or gate operating force under the specific flow and pressure requirements.

2.02 MANUAL VALVE OPERATORS

- A. General:
 - 1. Unless otherwise indicated, each manual operator shall be provided with an handwheel.
 - 2. Size operators to produce required torque with a maximum pull of 40 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 foot-pounds torque on the operating nut.
 - 3. Counter clockwise opening as viewed from the top, unless otherwise indicated.
 - 4. Unless otherwise specified, operators for valves to be buried, submerged, or installed in vaults or manholes, shall be sealed to withstand at least 20 FT of submergence.
 - 5. Extension stem:
 - a. Install where shown or specified.
 - b. Solid steel with actuator key and handwheel, diameter not less than stem of valve actuator shaft.
 - c. Pin all stem connections.
 - d. Center in valve box or grating opening band with guide bushing.
- B. Exposed Valve Manual Operators:
 - 1. Provide manual operators for all exposed valves not having electric or cylinder operators.
 - 2. Provide handwheels for gate and globe valves.
 - a. Size handwheels for valves in accordance with AWWA C500.
 - 3. Provide lever operators for plug valves, butterfly valves and ball valves 3 1/2 inches DIA and smaller.
 - a. Lever operators for butterfly valves shall have a minimum of 5 intermediate lock positions between full open and full close.
 - b. Provide at least two (2) levers for each type and size of valve furnished.
 - 4. Gear operators required for plug valves, butterfly valves, and ball valves 4 inches DIA and larger.
 - 5. Provide gearing for gate valves 20 inches and larger in accordance with AWWA C500.
 - 6. Gear operators to be totally enclosed, permanently lubricated and with sealed bearings.
 - 7. Provide galvanized chain and ductile iron chain wheels for chain operators.
 - a. For smaller valves with lever or handle operators, provide offset tee handles with attached chain for operation from the operating floor.
 - 8. Provide cast iron floor stands where indicated in the Drawings.
 - a. Stands to be furnished by valve manufacturer with operator.
 - b. Stands or operator to include thrust bearings for valve operation and weight of accessories.

- C. Submerged Valve Operators:
 1. Mount the valve operator on top of an extension bonnet 3 FT above any adjacent personnel access.
 2. The valve and bonnet connection shall be flanged and watertight.
 3. Provide a top brace support for the bonnet.
 - a. Mount the brace 6 IN below the top of the wall as shown.
 4. Materials:
 - a. Extension bonnet: Type 304 stainless steel.
 - b. Brace and anchor bolts: Type 304 stainless steel.
- D. Buried Valve Operators:
 1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
 2. Box base to enclose buried valve gear box or bonnet.
 3. Provide 2 IN standard operator nuts complying with AWWA C500.
 4. Provide at least two (2) tee handle keys, but no less than 1 key per every 10 valves for operator nuts, with 5 FT extension between key and handle.
 5. Extension stem:
 - a. Provide for buried valves greater than 4 FT below finish grade.
 - b. Extend to within 6 IN of finish grade.
 6. Provide concrete pad encasement of valve box as shown for all buried valves unless shown otherwise.

2.03 POWERED OPERATORS FOR VALVES AND GATES

- A. Type 1 operators:
 1. Valve operators shall be non-intrusive electronic type and have the following features:
 - a. A thermistor for thermal protection embedded in the motor windings.
 - b. Two independent and fully adjustable DPDT rotary type position switches as specified in this Section.
 - c. Two rotary type limit switches; 1 for opening, 1 for closing at end of travel.
 - d. A double torque switch.
 - e. Thermal overload protection for each leg of the 3-phase power supply, and control voltage transformer.
 - f. Position transmitter.
 - 1) Valve operator shall be provided with a solid state controller as specified in the Section.
 - 2) Valve operators shall be sized for an operating torque equal to twice the maximum required valve operating torque under specified flow conditions. Torque switches shall be set to disengage motor power at 75 percent of the shaft's design torque.
 - 3) Operators shall be suitable for use with 460V, 3-phase, 60-Hz power.
 - 4) Position transmitter shall generate a 4-20 mADC ungrounded (isolated) output based on the position of a 1,000 ohm potentiometer coupled directly to the shaft of rotary motion valves and to the operator gear train of linear motion valves or gates.
 - g. Local Control Stations:
 - 1) Each powered operator shall include a local control station.
 - a) Local control station functions shall be as indicated in the Drawings.
 - 2) Where indicated in the Drawings, provide local controls mounted integral with the operator enclosure.
 - 3) Where indicated in the Drawings, provide local controls mounted in an enclosure to be installed remote from the operator enclosure.
 - a) Enclosure: NEMA 4X.
 - b) Provide all required cabling between the operator enclosure and the local control enclosure.

2. Acceptable Manufacturers:
 - a. Limitorque.
 - b. Raymond Control Systems (RCS).
 - c. Approved Equal.

2.04 POWERED OPERATOR CONTROLS

- A. Solid State Controller:
 1. Accepts a 4 to 20 mA DC signal into a maximum load of 250 ohms and is electrically isolated.
 2. Controller positioning accuracy shall be 1.0 percent of travel or better with operating speeds of 12 inches per minute for linear operators and 180 degrees per minute for rotary operators.
 3. Acceptable manufacturers:
 - a. Limitorque Modutronic 30.
 - b. Raymond Control Systems (RCS) RI.
 - c. Approved Equal.
- B. Position Switches:
 1. Having Form C (SPDT) contacts rated not less than 10 amperes at 120V AC, 0.8 power factor and at 24V DC.
 2. Unless otherwise indicated, 1 set of limit switches set to actuate when the valve is less than 3 percent open and the second set to be set to actuate when the valve is more than 97 percent open.
 3. Limit switches: Enclosed in a NEMA 7 explosion-proof case and of rotary type positively coupled to the actuator.

2.05 HYDRAULIC OPERATORS FOR VALVES AND GATES

- A. Acceptable Manufacturer:
 1. For Effluent Isolation Gates:
 - a. REXA Inc., X2-L10000-60-D-P20-A.
 2. No substitutions.
- B. Design Requirements:
 1. Type of units: Linear hydraulic cylinder actuator with remote power unit.
 2. Construction: NEMA 4X.
 3. Fail safe mode: Fail closed (up position if downward acting, down position if upward acting).
 4. Fail mode speed: Matching normal gate closing speed as required by this Section.
 5. Fault monitoring relay: Yes.
 6. Cable connection: Quick release connectors.
 7. Seat loading method: Yes.
 8. Mechanical switches: Yes, low, high, over travel gate position switches.
 9. Output limit protection: 100 – 300% total output.
 10. Control signal: Modulating analog 4 – 20 mA with surge suppressor.
 11. Local controls: Actuator Control Panel (PNL854518 and PNL854528).
 12. Remote controls: By facility PLC in main control panel (PNL854881).
 13. Set up & calibration mode: Yes.
 14. Position Transmitter: Passive 4 – 20 mA.
 15. Software: Standard.
 16. Voltage/phase/Hz: 480V/3-phase/60Hz.
 17. Transformer:
 - a. Primary voltage: 480V/3-phase/60Hz. (From Motor Control Center).
 - b. Secondary voltage: 240V/3-phase/60Hz. (To Actuator Control Panels, PNL854518 and PNL854528).
 18. Power module: Local mount on equipment pad at gate (see Drawings).
 19. Gate: Effluent Gates.
 20. Maximum Stroke: 60 inches (as required for individual gate).

21. Stroke rate @ 100% speed: 2 seconds per foot of travel, electronically adjustable.
22. Rated Thrust output: 20,000 lbs max (to be limited).
23. Manual override: Manual pump and handwheel.
24. Hydraulic Hose: Size per manufacturer recommendation.
25. Accumulator: Size per manufacturer recommendations to allow for gate actuation to the closed position during a power failure.
26. Length: As indicated in the Drawings.
27. Duty: 100 percent continuous for modulating service.
28. Stop/Start: No limitation on number of starts/stops per hour.
29. Signal Repeatability: Minimum 0.10% of full travel.
30. Response: Virtually instantaneous with zero overshoot.
31. Force: Output sufficient to meet maximum required torque.
32. Gate Drift: Guaranteed at no more than 0.002 inches/min.
33. Gate Drift Correction: Adjustable down to 0.1 percent of gate travel distance. Initially set at 1 inch of drift before gate actuator corrects position.

C. Operation:

1. Position Indication:
 - a. Clearly indicate gate position locally, via a visible, mechanical apparatus, such as a color-coded rotary indication.
 - b. Include electric limit switches and position feedback.
2. Manual Operation:
 - a. Equipped with a mechanical means to operate the actuator when electrical supply power is not available.
 - b. Independent of the actuator hydraulics and capable of being isolated during normal operation of the actuator.
 - c. De-clutch manual hand-wheel.
3. Modes of Operation:
 - a. Have at least two modes of operation:
 - 1) Local control.
 - 2) Remote control.
 - b. Local control is defined as an operational state where the actuator is controlled from the Actuator Control Panel.
 - c. Remote control is defined as the operational state where the actuator is controlled from the plant control system PLC.
4. Fail-Safe Action:
 - a. Upon loss of primary power, the actuators shall fail in the closed position, remaining hydraulically locked in place until power is restored or manual operation is engaged.
 - b. Upon loss or discontinuation of control signal, the actuator shall be capable of failing and hydraulically locking fully open, fully closed, or in last position. The actuator shall be initially set to fail in the closed position.
 - c. Upon re-establishment of power, the gate will be programmed to remain in the closed (fail) position and only modulate when indicated to do so per the facility main control panel (see Section 17511 and 17551).

D. Hydraulic Requirements:

1. Slide Gate Actuator Cylinder:
 - a. Consist of a linear, double-acting piston cylinder assembly.
 - b. Provide direct transfer of linear travel to the gate.
 - c. Capable of being mounted in any position.
 - d. Provide sufficient force throughout entire gate stroke to overcome gate breakaway/seating friction and process dynamics.
 - e. Designed to operate at a standard internal hydraulic operating pressure of 2,000 psi, but will only generate the amount of internal psi to move the gate as required at any given moment.
 - f. Contain pressure limiting devices that allow the user to limit the internal pressure build-up of 2,200-2,300 psi maximum and field adjustable to lower values.

- g. Operation at a constant, standard internal pressure greater than 2,000 psi will not be accepted.
- h. Provide bleed off fitting to vent any air trapped inside the hydraulic hose.
- 2. Hydraulic Power Unit:
 - a. General:
 - 1) Completely self-contained.
 - 2) Provide all internal piping connections between the actuator and the gate cylinder for a complete system.
 - 3) No hydraulic tubing or connections to a separate hydraulic power unit (HPU) system or any other hydraulic pumping system.
 - 4) Employ motor or food grade oil for the hydraulic medium.
 - 5) Supplied from the manufacturer containing a maximum of 300 cubic inches of oil, completely purged of air, and hermetically sealed off from the environment.
 - 6) Require no additional oil volume after it ships from the manufacturer.
 - 7) Actuators requiring periodic oil maintenance (oil changes) will not be acceptable.
 - 8) Actuators requiring oil filtration, or containing any type of oil filtering means, will not be acceptable.
 - 9) Employ a hydraulic circuit that is double-acting, transferring oil from one side of the operating cylinder to the other. No oil shall be transferred to or removed from a reservoir when the actuator makes a position change. No centralized hydraulics employing active reservoirs (used during normal operation) shall be acceptable.
 - 10) No spring-opposed based hydraulic systems will be allowed.
 - 11) Accumulator provided for purposes of gate actuation during a power failure.
 - 12) The accumulator skids shall be vertical mounted as indicated in the Drawings.
 - 13) Provide a hand pump as a backup which is permanently attached to the power module.
 - b. Component Assembly:
 - 1) Drive train apparatus containing a bi-directional gear pump.
 - 2) Hydraulic circuit regulating equal volumes of oil flow into and out of the hydraulic cylinder.
 - a) Provide dual action:
 - (1) Act as a check valve in one direction.
 - (2) Act as a throttling valve for the hydraulic pump in the opposite direction.
 - (3) Valves shall direct hydraulic flow from the pump to cause the actuator to stroke in the direction indicated by the controller.
 - 3) Motor directly coupled to the pump within the hydraulic manifold.
 - a) The motor shall only operate when a gate position change is required.
 - b) No continuously running motors are acceptable.
 - c) Motors shall be of a brushless servo or stepper motor design. No induction motors will be acceptable.
 - 4) Manifold Reservoir:
 - a) Integral 2 oz., pressurized oil reservoir with an indicator button to show oil level.
 - b) Isolated from the normal hydraulic circuit by suction check valves and only be used for thermal expansion and contraction of oil in the closed-loop system.
 - c) Under a minimum of 20 psi positive pressure to eliminate atmospheric ingress.
 - 5) Include a thermostatically controlled cartridge heater in order to maintain appropriate oil viscosity in the event ambient temperatures should fall below 40° F.
 - a) Heaters supplied are only allowed for the purposes of maintaining oil viscosity.
 - b) Not be employed as condensation heaters.
 - c. During normal operation, when the motor/pump is stopped, the hydraulic circuit shall be closed, securely locking the actuator in place.
 - d. Hydraulic seals shall be rated for ~ 1 million full stroke cycles (~ 10 million “dither” cycles defined as <1.0% step changes) before recommended replacement for preventative maintenance. Hydraulic actuators designed for lower duty cycles with recommended seal upgrades for services less than 500,000 full stroke cycles are not allowed.

E. Electrical Requirements:

1. Actuator Control Panel (PNL854518 and PNL854528):
 - a. Separate control enclosure containing a dedicated programmable microprocessor controller.
 - b. Control electronics and signals:
 - 1) NEMA 4X stainless steel enclosure.
 - 2) Electrical controls/apparatus responsible for interpreting incoming control signal demand and directing actuator movement in an enclosure separate from the hydraulic portion of the actuator, connected by electrical cables.
 - 3) "On-board/all-in-one" electronics will not be acceptable.
 - 4) Capable of monitoring the incoming 4-20 mA control signals, while monitoring the real-time position of the hydraulic actuator, ensuring both control signal demand and current actuator position are in accordance with each other, as programmed by the dead-band setting of the actuator electronics (programmable down to 0.05% dead-band).
 - 5) A change in control signal outside of the dead-band setting will trigger the electronics to make a position change response by signaling the motor of the hydraulic actuator to respond accordingly.
 - c. Electrical surge protection for the electronics shall be supplied on both the incoming supply power and control signal connections.
 - d. Controller:
 - 1) Remote mounted microprocessor controller.
 - 2) Include the CPU board with a five button keypad LED display, motor driver, internal power supply and wire terminations.
 - 3) Mount in the control enclosure.
 - 4) Incorporate self-diagnostics.
 - 5) In the event of a system malfunction; an error code shall register on the LED display.
 - 6) Include a 4-20 mA position transmitter.
 - 7) Local controls:
 - a) Mounted on the cover of the control enclosure.
 - 8) Provide the user the ability to transfer between different modes of the supplied actuator, such as a "LOCAL", "AUTOMATIC" or "SET-UP" mode.
 - e. Provide the following minimum input and output signals and controls for interface with the plant control system:
 - 1) Position Command.
 - 2) Position Feedback.
 - 3) Gate Fault.
 - 4) Gate Warning.
 - 5) Gate Open.
 - 6) Gate Closed.
2. Slide Gate Actuator Cylinder:
 - a. Feedback potentiometer: directly mounted to the actuator output shaft for 1 to 1 ratio position readout.
 - b. Provide continuous position feedback.
 - c. Include the ability of gate actuator to transmit a 4-20 mA continuous position indication signal.
 - d. Design gate actuator with passive position transmitters.
3. Actuator manufacturer to supply cables for connections between the electronics and the hydraulic portion of the actuator.
 - a. Provide quick connect cables.
 - b. Cables require conduits: Separate conduits for all high voltage and low signal wiring connections.

2.06 OPERATOR APPURTENANCES

A. Valve Boxes:

1. Cast iron and having suitable base castings to fit properly over the bonnets of their respective valves and heavy top sections with stay-put covers.
2. Covers: Hot-dip galvanized.

- B. Floor Boxes:
 1. Hot-dip galvanized.
 2. Where operating nut is in the concrete slab: Floor box is bronze bushed.
 3. Where operating nut is below the slab: Opening in the bottom of the box to be sufficient for passage of the operating key.

- C. Adjustable Shaft Valve Boxes:
 1. Concrete or cast iron.
 2. Gas line covers: Impressed with the letter "G".
 3. Box covers on waterlines shall be impressed with the letter "IV".
 4. Acceptable manufacturers:
 - a. Brooks No. 3RT.
 - b. Christie G5.
 - c. Empire 7-1/2 valve extension box.
 - d. Approved Equal.

2.07 GATE OPERATORS

- A. General:
 1. Unless otherwise indicated, operators shall meet AWWA C563 or C561 specifications, as appropriate, and shall be designed to meet the operating requirements as specified within this Section. Provide clear plastic stem covers as specified in AWWA C563, Section 4.4.13.6.
 2. Pedestal mount on a stand for Type P operator mount. Yoke mount on self-contained gate frame for Type Y operator mounts.
 3. Where Type P operator mount is specified, mount actuator on a high-strength cast-iron pedestal base.

- B. Type MH, Manual Gate Operator with Handwheel:
 1. General: Manual, direct drive handwheel without reduction gearing.
 2. A maximum effort of 40 pounds pull on the handwheel shall operate the gate under the specified operating conditions.
 3. Operating nut: Internally threaded with standard ASME B1.5 29-degree acme threads corresponding to stem threading.
 4. Tapered roller bearings or ball bearings: Locate above and below the bronze operating nut to support the output thrust of the floor stand.

- C. Type MC, Manual Gate Operator with Crank:
 1. General:
 - a. Manual, geared, crank type.
 - b. Pedestal mount on a floor stand.
 - c. Removable and self-locking at any position of stem travel.
 - d. Crank: 15 inches long.
 - e. Actuator gear box: Enclose gears and bearings in a weatherproof cast-iron housing with bronze operating nut, and provide pressure type fittings for grease lubrication of the bearings and gears. A maximum effort of 40 pounds pull on the crank shall operate the gate under the specified operating conditions.
 - f. Operating nut: Internally threaded with standard ASME B1.5 29-degree acme threads corresponding to stem threading.
 - g. Tapered roller bearings or ball bearings: Locate above and below the bronze operating nut to support the output thrust of the floor stand.
 - h. Pinion shaft: Mount on tapered roller bearings to resist axial and radial thrusts.
 - i. Mechanical seals: Provide around the operating nut and the pinion shaft to prevent lubrication from leaving the unit and moisture from entering the sealed housing.
 - j. Reduction gear case: Precision machined and equipped with tapered roller or needle bearings and sealed about the reduction shafts.
 - k. Input shaft: Fitted with an AWWA standard 2-inch square nut.

- D. Type E, Electric Operator:
1. General: Operating mechanism for the gate consists of bevel gear box electric motor operator, intermediate shafts with flexible couplings (if required), a position indicator, and all necessary appurtenances.
 - a. Bevel gear box:
 - 1) Fabricated of steel, and of the right angle bevel gear type designed for use with a slide gate.
 - 2) Designed for the actuator mount configuration (Type P or Y) specified in this Section.
 - 3) Galvanize after fabrication.
 2. Gears: Heat-treated bevel type, running in lubricant.
 3. Bearings: Heavy-duty anti-friction type.
 4. Stem nuts:
 - a. High-tensile manganese bronze, accurately machined and mounted.
 - b. Thread length: Not less than 2.25 times the stem diameter.
 5. Motor operator: As specified in Section 2.03.
 6. Intermediate shafts and flexible couplings:
 - a. Shafts between the motor stand and bevel gear pedestals: Cold finished turned and ground shafting.
 - b. Flexible couplings: Provide at connection points to all gear units.
 7. Position indicator:
 - a. Mechanical gate position indicator in a waterproof housing.
 - b. An additional electrically isolated contact shall be provided with the mechanism to be open when the gate is in the extreme up position and closed at all other times.
- E. Type HC, Hydraulic Cylinder: As specified in the Section.

2.08 SPARE PARTS

- A. Procedures: Section 01750.
- B. For each size type 1 operator:
1. One electric motor.
 2. One operating nut per stem.
 3. One complete set of torque and limit switches with gears.
- C. For hydraulic operator:
1. One spare handwheel for manual operation during a power outage.
 2. One seal kit per gate.
 3. One oil gun.

PART 3 EXECUTION

3.01 GENERAL (NOT USED)

3.02 MANUAL OPERATORS

- A. General: Unless otherwise indicated, valves and gates shall be provided with manual operators. Manual operators shall be positioned so that they can readily be operated.
- B. Wrench nuts: 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 inches of the valve box cover.

- C. Chain wheels:
1. Unless otherwise indicated, valves with centerlines more than 7 feet 6 inches above the specified operating level shall be provided with chain wheels and operating chains.
 2. The valve shall be properly rotated so the chain wheel can function correctly. Hand wheel shall not be on top in the vertical position.
 3. Chain wheel operated valves shall be provided with a chain guide.
 4. Operating chains shall be looped to extend within 4 feet of the specified operating level below the valve.
 5. For plug-type valves 8 inches and larger, the operator shall be provided with a hammer blow wheel.
 6. Hooks on adjacent piping shall be provided for chain storage where chain hangs in foot traffic.

3.03 POWERED OPERATORS

- A. Powered operators shall have their manual operating accessory, where specified, mounted and operable from the floor.

3.04 POWERED OPERATOR CONTROLS

- A. Electropneumatic positioner: Provided for throttling services.
- B. Controllers for Type 4 and Type 6 Operators:
1. Two sets of adjustable limit switches and a solenoid pilot valve shall be provided for isolating services.
 2. Pilot valves shall be separately mounted from cylinders at a height not to exceed 6 feet above the floor or a permanent work platform.

3.05 HYDRAULIC OPERATORS

- A. Mechanical: Performed by factory technician employed by the actuator manufacturer.
- B. Electrical: Provide factory technician assistance.

3.06 OPERATOR APPURTENANCES

- A. Valve Boxes: Extending to finished surfaces, provided for buried valves.
- B. Floor Boxes:
1. Provided for wrench operation of valves located below concrete slabs.
 2. Each floor box and cover shall be of the depth required for installation in the slab.

3.07 FIELD COATING

- A. See Section 09900.

3.08 FIELD QUALITY CONTROL

- A. For all electric and hydraulic actuators, employ and pay for services of actuator manufacturer's field service representative to:
1. Inspect actuators covered by this Section.
 2. Supervise adjustments and installation checks:
 - a. Open and close valves or gates electrically or hydraulically under local manual and demonstrate that all limit switches are properly adjusted and that switch contacts are functioning properly by verifying the inputs are received at the remote input/output (RIO) panels or local control panel as appropriate.

- b. Position modulating valves or gates electrically or hydraulically under local manual control and demonstrate that the valve position feedback potentiometer is properly adjusted and that the feedback signal is received at the RIO panels or local control panel as appropriate.
 - c. Simulate a valve or gate position command signal at the RIO panel or local control panel as appropriate and demonstrate that the valve or gate is controlled to the desired position without excessive hunting.
3. Provide Owner with a written statement that the actuator manufacturer has verified that the actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted and that the actuator responds correctly to the valve or gate position command.

END OF SECTION

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SECTION 15150
SPECIALTY VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies specialty valves which are auxiliary to process piping systems.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

Reference	Title
AWWA	American Water Works Association
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM D3222	Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials
ASTM D4801	Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data detailing materials, construction, dimensions, weight, flow capacity, performance charts or tables and pressure loss curves.
- C. Installation shop drawings.

PART 2 PRODUCTS

2.01 CORROSION RESISTANT FLAP GATES

- A. Equipment Schedule:

Equipment Number	Valve Name	Size (inches)
V854733	OCU 1 Flap Gate 1	4
V854734	OCU 1 Flap Gate 2	4
V854735	OCU 2 Flap Gate	4
V854407A	MH-3 Flap Gate 1	4
V854407B	MH-3 Flap Gate 2	4
V854407C	MH-3 Flap Gate 3	4
V854407D	MH-3 Flap Gate 4	4
V854408A	MH-4 Flap Gate 1	16
V854408B	MH-4 Flap Gate 2	12
V854408C	MH-4 Flap Gate 3	4
V854408D	MH-4 Flap Gate 4	4

Equipment Number	Valve Name	Size (inches)
V854408E	MH-4 Flap Gate 5	4

B. Materials:

1. Body: Fiberglass reinforced plastic (FRP).
2. Seals and Hinges (Trim): neoprene, conforming to ASTM D2000.
3. Flap: Molded neoprene with solid FRP cover and vulcanized steel plate core.
4. Mounting Hardware: 316 SST.

C. Heavy-duty, one-piece molded flexible hinge/flap assembly.

D. Body:

1. Resin suitable for low pH, acid service exposure for interior and exterior of the valve.
2. Ultraviolet stabilized.
3. Inner and outer surfaces: C-glass surfacing veil with 20 mil resin rich (95 percent by weight) corrosion liner.
4. Laminate shall meet the visual defect criteria of Section 13230.

E. Seals and Hinges:

1. Flush mounted on the body with 316 SST hardware.
2. Durometer: 45-65 shore A.
3. Maximum compression set of 25 percent.
4. Low temperature brittleness meeting suffix F-17.

F. Flap:

1. Suitable for low pH, acid service.
2. Ultraviolet stabilized.
3. Seamless composite construction.
4. Raised, rounded 1/8 inch wide seating surface.

G. Mounting:

1. Circular frame with integral flat-face flange suitable for mounting to a 125 lb flange.
2. Mount to chemical drain pipe flange at location indicated in the Drawings.

H. Performance:

1. No adjustment required after installation to provide for water tight seal.
2. Valve shall open to release flow at no greater than 12 inches of upstream fluid pressure.
3. Valve shall be weighted to seal leak tight when flow through valve stops and there is zero seating pressure.
4. Valve shall withstand up to 10 ft of seating pressure with a deflection of less than L/360 of the gate width.

I. Acceptable manufacturers:

1. Plasti-Fab (Circular Titeseal).
2. Approved Equal.

2.02 MUD VALVES

A. Equipment Schedule:

Equipment Number	Valve Name	Size (inches)
MDV854440	Coagulant Storage Sump Drain	4
MDV854450	Caustic Storage Sump Drain Valve	4
MDV854441	Coagulant Pump Room Sump Drain Valve	4
MDV854451	Caustic Pump Room Sump Drain Valve	4

- B. Materials:
 - 1. Body (cover and frame): HDPE, ASTM D4801.
 - 2. Stem: Type 316 stainless steel.
 - 3. Anchor bolts and assembly bolts: Type 316 stainless steel.
- C. Assembly:
 - 1. One-piece assembly with a non-rising stem, a movable cover and a fixed integral frame.
 - 2. The frame will have a bolt pattern to mount to a concrete floor.
 - 3. The cover shall be designed to lower into place over the opening for tight shut-off. A resilient seal at the bottom of the cover.
- D. Stem:
 - 1. Extension one-piece Type 316 stainless steel, wall bracket with position indicator.
 - 2. Stem guides Type 316 stainless steel for L/R of 200 maximum.
- E. Model and Manufacturers:
 - 1. Model RW7200-P by RW Gate.
 - 2. Approved Equal.

2.03 AIR RELEASE VALVES (ARV) - WATER SERVICE

- A. Materials:
 - 1. Body and cover: Cast iron.
 - 2. Float: Type 316 stainless steel.
 - 3. Seat: Synthetic rubber.
 - 4. Other internal parts: Type 316 stainless steel.
- B. Float operated, simple lever type.
- C. Suitable for pressures up to 150 psi.
- D. Acceptable manufacturers:
 - 1. APCO, Model 200A.
 - 2. Crispin, P10.
 - 3. Approved Equal.

2.04 AIR RELEASE VALVES (ARV) - SEWAGE

- A. Materials:
 - 1. Body, Base, and Clamping Stem: reinforced Nylon.
 - 2. Discharge Outlet: Polypropylene.
 - 3. Float Assembly: Stainless steel 316 and Foamed polypropylene.
 - 4. O-ring: Buna-N.
 - 5. Rolling Seal: EPDM
 - 6. Ball Valve: ¼", Stainless steel 316.
- B. Working pressure range: 3 – 150 psi.
- C. Connection: NPT male threaded connection or flanged.
- D. Spare parts: provide a complete spare valve.
- E. Acceptable manufacturers:
 - 1. ARI, S-025.
 - 2. Approved Equal.

2.05 AIR RELEASE VALVES (ARV) - CHEMICAL

A. Equipment Schedule:

Equipment Number	Valve Name	Size (inches)
ARV854441	Train 1 Coagulant Injection Line Air Release Valve	1/2
ARV854443	Train 2 Coagulant Injection Line Air Release Valve	1/2
ARV854451	Train 1 Caustic Injection Line Air Release Valve	1/2
ARV854453	Train 2 Caustic Injection Line Air Release Valve	1/2

B. Materials:

1. Body: PVC or CPVC.
2. Seal: Viton.

C. NPT threaded inlet and outlet. Float designed to automatically vent gases.

D. 150 psi design pressure.

E. Acceptable manufacturers:

1. Plast-O-Matic; Series DGV.
2. Primary Fluid System, Inc; Accu-Vent.
3. Approved Equal.

2.06 AIR VACUUM VALVES (AVV) – WATER AND SEWAGE

A. The vacuum relief air inlet valve shall consist of a body, baffle, float, seat, stainless steel spring with a galvanized iron hood to prevent debris entering.

B. The seat shall be Buna-N, fastened to the cover without distortion and have a flow area equal or greater than the valve inlet size, to insure full vacuum relief protection during draining, pipeline rupture or water column separation.

C. The orifice shall open, allowing air entry, when a vacuum exceeds 0.25 psi or less. The float shall be stainless steel, rated for 500 psi, and center guided, for drop tight shutoff, and normally closed by a stainless steel spring.

D. The valve shall have globe type body, integrally cast-on flanged ends, and a cross-sectional inflow area 10% greater than equivalent pipe size of valve, for full vacuum relief protection. The internal valve plug and seat shall be heavy cast brass, the seat retained in the body by a heavy cover, have a resilient Buna-N seal for positive shut-off and plug, center guided both ends, to prevent jamming. The plug shall be normally closed, by means of a stainless steel spring and shall open when a vacuum exceeds 0.25 psi or less.

E. Acceptable manufacturers:

1. APCO Series S-1500-8".
2. Approved Equal.

2.07 AIR VACUUM VALVES (AVV) - CHEMICAL

A. Equipment Schedule:

Equipment Number	Valve Name	Size (inches)
AVV854441	Train 1 Coagulant Injection Line Air Vacuum Valve	1/2
AVV854443	Train 2 Coagulant Injection Line Air Vacuum Valve	1/2
AVV854451	Train 1 Caustic Injection Line Air Vacuum Valve	1/2

Equipment Number	Valve Name	Size (inches)
AVV854453	Train 2 Caustic Injection Line Air Vacuum Valve	1/2

- B. Direct acting diaphragm, spring controlled, in-line pattern, NPT threaded inlet and outlet, 150 psi design pressure.
- C. PVC body, Teflon or Viton diaphragm, PVC or Teflon piston, high-density polyethylene or stainless steel adjusting bolt and locknut, stainless steel or coated steel spring, stainless steel fasteners.
- D. Designed to open when upstream pressure reaches setpoint; set pressure adjustable from 10 psi to 100 psi, minimum. Factory set pressure setting at 25 psi.
- E. Acceptable manufacturers:
 1. Plast-O-Matic; Series RVDT.
 2. Griffco; Series BPV.
 3. Primary Fluid System, Inc; TOP valve.
 4. Approved Equal.

2.08 COMBINATION AIR AND VACUUM RELIEF VALVES (CAVRV)

- A. The combination air and relief vacuum valve combines an air and vacuum large orifice and an automatic small orifice in a single body.
- B. Valve Connections:
 1. 4 inches and larger: flange.
 2. 3 ½ inches and smaller: threaded.
- C. The valve shall be designed to operate with sewer liquids carrying solid particles in sewage. The valve shall discharge air during the filling or charging of the system and admits air to the system while it is being emptied of liquid and discharges accumulated air from the system while it is under pressure and operating. The valve shall provide complete separation of the liquid from the sealing mechanism and provides optimum work conditions. At any time during system operation, when internal pressure fall below atmospheric pressure the valve shall allow re-enter the air to the system to prevent pressure surges and other destructive phenomena. The valve shall insure full vacuum relief protection during draining, pipeline rupture or water column separation. The orifice shall open, allowing air entry when internal pressure falls below the atmospheric pressure. The valve shall provide drop tight shutoff in normal operation closed position.
- D. The valve shall operate at pressure range of 3 to 250 psi. The valve design shall prevent any contact between sewage and the sealing mechanism by creating an air gap at the top of the valve. The valve shall be equipped with 1 inch stainless steel ball valve for drain and cleaning.
- E. The combination air and relief vacuum valves shall be A.R.I Series D-020-2 inch, D-023-4 inch, or approved equal, depending on the application.
- F. Materials: Materials of construction shall be as follows:

COMPONENT	MATERIAL
Body	Stainless steel 316
Cover	Stainless steel 316
Disc and arm assembly	Stainless steel 316
Float assembly	Stainless steel 316
Bolts, nuts, washers and rivets	Stainless steel 316
Spring and other metal parts	Stainless steel 316
O-Rings	BUNA-N.

COMPONENT	MATERIAL
Disc Seals	E.P.D.M
Drain valve, ball valve 1"	Stainless steel 316

2.09 HOSE VALVES

- A. Unless specified otherwise, hose valves shall be a brass angle valve, composition disc, with threaded nipple adapter for hose connection.
- B. Acceptable manufacturers:
 1. Crane 17.
 2. Lunkenheimer 214.
 3. Powell 151.
 4. Approved Equal.

2.10 FLUSHING COCKS

- A. Unless otherwise indicated: 1 -inch full port valve with stainless steel ball and stem.
- B. Body material: match pipe material.
- C. Neoprene-faced eccentric plug valve with a hose nipple adapter if required:
 1. Acceptable manufacturers:
 - a. DeZurik 159/118-S.
 - b. Keystone Fig 541.
 - c. Approved Equal.

2.11 QUICK DISCONNECTS

- A. Universal quick-acting twist-lock claw coupling per Section 15200.
- B. Shall not be disconnectable under pressure.
- C. Air service:
 1. Shall be 1/2 inch, unless otherwise specified.
 2. Acceptable manufacturers:
 - a. Swagelok.
 - b. Tomco.
 - c. Approved Equal.
- D. Water service:
 1. Shall be 1 inch, unless specified otherwise.
 2. Acceptable manufacturers:
 - a. EverTite Part B.
 - b. Gate Part B.
 - c. Approved Equal.

2.12 STOP AND DRAIN VALVES

- A. Quarter turn.
- B. Brass or Bronze body with threaded ends.

- C. Acceptable manufacturers:
 - 1. Mueller H-10284.
 - 2. The Engineer knows of no equal.

2.13 DIAPHRAGM VALVES (1/2 TO 4 IN)

- A. Material:
 - 1. Body: CPVC, ASTM D1784.
 - 2. Diaphragm: EPDM backed Teflon.
 - 3. Bolts and other external hardware: 304 stainless steel.
 - 4. Indicating Rod: 304 stainless steel.
 - 5. Bonnet: CPVC, ASTM D1784.
 - 6. O-rings: EPDM.
 - 7. Hand wheel: polypropylene.
 - 8. Gas barrier: PVDF, ASTM D3222, cell classification Type 11.
- B. End Connections:
 - 1. Flanged or true union.
- C. Valve Style:
 - 1. Weir.
 - 2. Adjustable travel stops.

2.14 BALL CHECK VALVES (1/2 TO 4 IN)

- A. 150 psi at 73 DegF.
- B. Acceptable manufacturers:
 - 1. R&G Sloane.
 - 2. Corr Tech.
 - 3. Approved Equal.
- C. Materials:
 - 1. Body: CPVC.
 - 2. Ball: Glass filled or polypropylene.
 - 3. Seals: EPDM.
- D. Design Requirements;
 - 1. Connectors; Double union.

2.15 SWING CHECK VALVES (2 1/2 IN AND SMALLER)

- A. Class 125 Bronze Swing Check Valves:
 - 1. Comply with MSS SP-80.
 - 2. Acceptable manufacturers:
 - a. Nibco.
 - b. Stockham.
 - c. Approved Equal.
 - 3. Materials:
 - a. Body, bonnet, disc: Bronze.
 - 4. Design requirements:
 - a. 125 psi steam to 406 DegF, 200 psi WOG.
 - b. Horizontal swing, renewable disc.
 - c. Solder, flange adapter, or NPT connections.

2.16 SEISMIC GAS SHUT-OFF VALVE

- A. Comply with ASCE/ANSI/SEI 25-06.
- B. Design Requirements:
 - 1. UL Listed.
 - 2. Visual status window.
 - 3. Manual reset.
 - 4. Rated for 7 psi minimum.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and as indicated in the Drawings.
- B. Install seismic gas shut-off valve downstream of each building pressure regulator.

3.02 FIELD TESTS

- A. Each valve, after installation and connection to the piping system, shall be cycled three times manually or utilizing the manual override to demonstrate proper operation.
- B. Each valve, upon completion of installation of the piping system, shall be cycled to fully demonstrate proper operation and confirm that operating times, under both normal operating, and emergency closure conditions, are as specified.
- C. Perform all adjustments necessary to bring the equipment into conformance with the Specifications.

END OF SECTION

SECTION 15200

HOSES AND NOZZLES FOR UTILITY STATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies hoses, connectors and nozzles for utility stations.

1.02 QUALITY ASSURANCE (NOT USED)

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's product data.

PART 2 PRODUCTS

2.01 HOSE

- A. Reinforced rubber plies pressure rated for a minimum working pressure of 300 psig.
- B. Resistant to heat, sunlight, ozone and weathering. Meet or exceed RMA Class C medium oil resistance. Temperature range: -40 degrees F to 212 degrees F.
- C. Suitable for both air and water service.
- D. Color: Red.
- E. Acceptable Manufacturers:
 - 1. Parker/Dayco Series.
 - 2. Gates.
 - 3. Approved Equal.

2.02 NOZZLES

- A. Chrome-plated brass, or bronze, or stainless steel.
- B. Plain fire hose type, 8 inches long.

2.03 QUICK CONNECTIONS

- A. Malleable Iron.
- B. Provide quick connect couplings at each end of hose and on the nozzle.
- C. Not be disconnectable under pressure.
- D. Acceptable Manufacturers:
 - 1. Dixon Air King.
 - 2. Chicago Pneumatic.
 - 3. Approved Equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. At locations indicated in the Drawings.
- B. Provide at each utility station
 1. One 30 foot length of 1-inch hose.
 2. One nozzle.
 3. Quick connection couplings at each end of hose, on the utility station valve, and on the nozzle.
 4. Equip nozzle with a ball valve at nozzle.

END OF SECTION

SECTION 15260

INSULATION FOR EXPOSED PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies thermal and sound insulation for exposed piping and equipment. Ductwork insulation is specified in Section 15846.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate Calcium
ASTM C533	Silicate Block and Pipe Thermal Insulation Preformed Flexible
ASTM C534	Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C552	Cellular Glass Thermal Insulation
ASTM E96	Water Vapor Transmission of Materials
FEDSPEC L-P-535E	Plastic Sheet (Sheeting) "Plastic Strip" Poly (Vinyl Chloride) and Poly (Vinyl Chloride-Vinyl Acetate), Rigid
FEDSPEC HH-I-558C	Insulation, Blankets, Thermal (Mineral Fiber, Industrial Type)

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's descriptive literature, including insulation and jacket thickness, heat transfer coefficient, and methods of installation.
- C. Samples of each insulation material type and of typical jackets and covers for fittings, valves and appurtenances.
- D. Certification of jacket ratings for water vapor transmission and puncture and stiffness as specified.

PART 2 PRODUCTS

2.01 GENERAL

- A. Piping insulation shall be tubular type or the flexible blanket type.
- B. Insulation for valves, strainers, fittings, expansion joints, flanges and other connections shall be segmented sections, molded, or blanket type coverings of the specified type and thickness of pipe insulation or the flexible blanket type.
- C. Equipment insulation shall be flexible blanket type or rigid board type cut to fit the surface.
- D. Polyethylene storage tank insulation: see Section 13205.

2.02 OPERATING REQUIREMENTS

- A. Temperature Classes:
 - 1. Insulation for exposed piping and equipment is classified for the following temperature ranges: low, medium, high, and very high:
 - a. Low temperature class insulation shall be suitable for an operating temperature range of minus 100 to plus 100 degrees F.
 - b. Medium temperature class insulation shall be suitable for an operating temperature range of 100 to 800 degrees F.
 - c. High temperature class insulation shall be suitable for an operating temperature range of 800 to 1200 degrees F.
 - d. Very high temperature class insulation shall be suitable for an operating temperature range of 1200 to 2000 degrees F.

2.03 INSULATION

- A. General:
 - 1. Low temperature class insulation shall be of the unicellular elastomeric thermal, cellular glass, fiberglass, or polyurethane foam type.
 - 2. Medium temperature class insulation shall be of the cellular glass or fiberglass type.
 - 3. High temperature class and very high temperature class insulation shall be of the calcium silicate type or the flexible blanket type.
 - 4. Piping and equipment subjected to vibration (such as engine exhaust) shall be insulated with flexible blanket type.
- B. Unicellular Elastomeric Thermal Type: Unicellular elastomeric thermal type insulation shall conform to the requirements of ASTM C534, Type I.
- C. Cellular Glass Type: Cellular glass type insulation shall conform to the requirements of ASTM C552, Type II.
- D. Fiberglass Type: Fiberglass type insulation shall conform to the requirements of FEDSPEC HH-I-558B.
- E. Polyurethane Foam Type: See Section 13205.
- F. Calcium Silicate Type: Calcium silicate type insulation shall conform to the requirements of ASTM C533, Type II, Class C.
- G. Flexible Blanket Type:
 - 1. High Temperature Class:
 - a. High temperature insulation shall be removable 1-inch or 2-inch thick blanket-type insulation designed for continuous 1200 degree F service.
 - b. The blanket shall be a custom sewn, flexible, reusable jacket, custom designed to closely fit the piping or the equipment housing.
 - c. Blanket shall be custom fitted to not restrict access to any instrumentation or equipment.
 - d. Insulation shall not compact or shake down in vibrating service.
 - e. Blanket insulation shall consist of a noncombustible silica cloth jacket and non-asbestos white ceramic fiber insulation.
 - f. Acceptable manufacturers:
 - 1) Thermazip Hi-Temp blanket Style 2000-60-3000 by Accessible Products Company.
 - 2) Hitco AIM.
 - 3) Advanced Thermal Products.
 - 4) SEI Temp-Set 1200.
 - 5) Approved Equal.

2. Very High Temperature Class:
 - a. Very high temperature insulation shall be removable 1-inch or 2-inch thick blanket-type insulation designed for continuous 2000 degree F service.
 - b. The blanket shall be a custom sewn, flexible, reusable jacket, custom designed to closely fit the piping or the equipment housing.
 - c. Blanket shall be custom-fitted to not restrict access to any instrumentation or equipment
 - d. Insulation shall not compact or shake down in vibrating service.
 - e. Blanket insulation shall consist of a noncombustible silica cloth jacket and high purity alumina and silica non-asbestos white ceramic fiber insulation.
 - f. Acceptable manufacturers:
 - 1) Thermazip Hi-Temp blanket Style 2000-61-3000 by Accessible Products Company.
 - 2) Hitco AIM.
 - 3) Advanced Thermal Products.
 - 4) Approved Equal.

2.04 INSULATION THICKNESS SCHEDULE

- A. The insulation dimensional tolerances shall comply with the specified standards. Equipment insulation shall match thickness of attached piping. The minimum insulation thicknesses, exclusive of jacket, shall be as follows:

Insulation Thickness (INCHES) for Nominal Pipe Sizes¹ and Tanks

Piping/Tank Service ²	Fluid temperature °F	Tanks	1 inch and less	1.25 to 2 inches	2.5 to 4 inches	6 inches	8 inches and larger
RD, D	10-70		1	1	1	1	1
EE:	800-1800				4	4	4
C1, C2, C3, C4, DH, TW	50-130		1	1.5	1.5	1.5	1.5
NaOH	50-70	2	1				
COAG	50-70	2	1				
RS	40-70				1.5	1.5	1.5
CD	40-70			1.5	1.5		
HW, HWR	120-140		1	1.5			
FOS, FOR	40-80		1				

¹ See specification Section 15050.

² Additional insulation requirements are specified in the Remarks at the end of individual piping system spec sheets in Section 15050.

2.05 PIPE INSULATION JACKETS

- A. Laminated Jackets: Laminated jackets shall consist of aluminum and white kraft paper. Jackets shall have a perm rating for water vapor transmission of not more than 0.02 in accordance with procedure A of ASTM E96.
- B. Aluminum Jackets:
 1. Aluminum jackets shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Jackets shall be 0.016 inch thick.
 2. Sheet metal screws shall be aluminum or stainless steel.
 3. Jackets shall be secured with 0.020 by 3/4-inch type 304 stainless steel expansion bands.

2.06 FITTING INSULATION COVERS

- A. Polyvinylchloride (PVC) Covers: Polyvinylchloride covers shall be one piece, premolded polyvinylchloride conforming to FEDSPEC L-P-535E, Composition A, Type II, Grade E4.
- B. Aluminum Covers: Aluminum covers shall be constructed of smooth finish aluminum sheet conforming to ASTM B209, alloy 5005, temper H16, with integral vapor barrier. Covers shall be 0.016 inch thick.
- C. Soft Covers: Soft covers shall be of the reusable type with TFE-coated fiberglass covers and liner.

2.07 SHIELDS

- A. Unless otherwise indicated, thermal pipe hanger shields shall be provided at pipe supports. Thermal hanger shields shall be as specified in Section 15096.

2.08 FLASHING

- A. Flashing shall include aluminum caps, sealant and reinforcing. Aluminum caps shall be 20 gage thick and shall be cut to completely cover the insulation. Sealants shall be as recommended by the insulation manufacturer.
- B. Reinforcement in flashing heated up to 370 degrees F shall be nylon fabric. Reinforcement in flashing for hotter surfaces shall be wire mesh or as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Apply insulation per manufacturers recommendations over clean, dry surfaces. Double layer insulation, where specified or required to achieve the specified surface temperature, shall be provided with staggered section joints.
- B. Pipe Supports and Shields: Unless otherwise indicated, supply thermal pipe hanger shields and install them during pipe support installation. Where thermal pipe hanger shields are used, apply the following to all butt joints:
 - 1. On hot pipe systems, apply 3-inch wide vapor barrier tape or band over the butt joints.
 - 2. On cold water, chilled water, or refrigerant piping, apply a wet coat of vapor barrier lap cement on all butt joints and seal the joints with a minimum 3-inch wide vapor barrier tape or band.
- C. Protection: Protect insulation and jackets from crushing, denting, and similar damage during construction. Vapor barriers shall not be penetrated or otherwise damaged. Remove any insulation, jacket, and vapor barriers damaged during construction and install new material.
- D. Piping Insulation:
 - 1. General:
 - a. Do not insulate piping until satisfactory completion of required pressure testing.
 - b. Pipe: Insulate piping continuously along its entire length including all in-line devices such as valves, fittings, flanges, couplings, strainers and other piping appurtenances. Unless otherwise indicated, provide piping insulation with laminated jackets specified in this Section.
 - 1) Insulation shall be butted firmly together and jacket laps and joint strips provided with lap adhesive. Provide:
 - a) Insulation jackets with their seams located on the underside of pipe.
 - b) Do not use PVC covers as specified in this Section with medium, high, or very high temperature class insulation.

- c) Removable flexible blanket-type insulation need not be jacketed.
 - c. Fittings, Connections, Flanges and Valves:
 - 1) Provide fitting, connection, flange and valve insulation with covers specified in this Section.
 - 2) Secure insulation in place with 20-gage wire and a coat of insulating cement. Covers shall overlap the adjoining pipe insulation and jackets. Install covers with their seams located on the underside of fittings and valves.
 - 2. Low Temperature Class:
 - a. Pipe: Seal off ends of insulation with a vapor barrier coating.
 - b. Fittings, Connections, Flanges and Valves:
 - 1) Except where soft covers are specified, provide insulation for pipe sizes 2-inches and less with rigid PVC covers specified in this Section.
 - 2) Seal covers at edges with vapor barrier adhesive. Secure the ends of covers with vinyl tape. The tape shall overlap the jacket and the cover at least 1-inch. Do not penetrate vapor barrier.
 - 3) Except where soft covers are specified, provide insulation for pipes 2 1/2-inches and larger with rigid aluminum covers specified in this Section. Mechanically secure covers using corrosion-resistant tacks pushed into the overlapping throat joint.
 - 3. Medium, High, and Very High Temperature Class:
 - a. Pipe: Except for flexible blanket type insulation, seal ends of insulation with end joint strips and use waterproof adhesive to hold them in place.
 - b. Fittings, Connections, Flanges and Valves:
 - 1) Except where soft covers are specified, provide rigid insulation with rigid aluminum covers specified in this Section.
 - 2) Mechanically secure covers using corrosion-resistant tacks pushed into the overlapping throat joint.
 - 4. Outdoor Piping:
 - a. Pipe:
 - 1) Provide rigid insulation with aluminum jackets specified in this Section.
 - 2) Design flexible blanket-type insulation for outdoor, weather-exposed service. Where piping emerges from soil without concrete or asphalt overtop, extend the insulation a minimum of 12-inches below the finished ground level. Where piping emerges from concrete or asphalt, extend the insulation to within 1-inch of the finished surface. Do not push insulation into contact with the finished concrete or asphalt surface.
 - b. Insulation over Heat Tracing:
 - 1) Provide heat tracing in specified locations indicated in the Drawings, and as specified in this Section.
 - 2) Install insulation over the top of heat tracing according to the specifications of the heat trace tape and insulation manufacturers.
 - c. Fittings, Connections, Flanges and Valves:
 - 1) Provide rigid insulation with rigid aluminum covers specified in this Section
 - 2) Design flexible blanket type insulation for outdoor, weather-exposed service.
- E. Mechanical Equipment Insulation:
- 1. General:
 - a. Unless otherwise specified, fit insulation to the contours of equipment and secure it with 1/2-inch by 0.015-inch galvanized steel bands. Weld pins or stick clips with washers may be used for flat surfaces and spaced a maximum 18-inches apart. Stagger joints and fill voids with insulating cement. Unless otherwise specified, provide insulation with laminated jackets specified in this Section.
 - b. Unless specifically specified to be uninsulated, insulate all equipment connected to insulated piping.
 - 2. Outdoor Equipment: Provided insulation with a coat of weatherproof mastic and a layer of open-weave glass cloth embedded into a wet tack coat. Overlap seams at least 2-inches. Provide a finish coat of weatherproof mastic. The total coating thickness shall be a minimum of 1/8 inch.

3. Low Temperature Class:
 - a. Where joints, breaks, and punctures occur in the insulation, seal them in facing with fire-retardant vapor barrier adhesive reinforced with 4-inch tape.
 - b. Provide insulation with a layer of open-weave glass cloth embedded into a wet coat of fire-retardant adhesive. Overlap seams at least 2-inches. Provide a finish coat of fire-retardant adhesive.
 4. Medium Temperature Class:
 - a. Cover joints and cement them in place with 4-inch-wide strips of the same material as the laminated jackets specified in this Section.
 5. High and Very High Temperature Class:
 - a. Cover high and very high temperature equipment with custom-fitted removable blanket-type insulation. Secure blanket-type insulation with stainless steel wire lacing and hooks. Overlap ends of blanket segments to prevent gaps and voids when the piping and equipment are heated. Secure blankets snugly under nuts and bolt heads to assure complete coverage during operation and to prevent vibration-induced gaps or voids. Secure blankets in strict accordance with the manufacturer's instructions. The blanket insulation thickness for high and very high temperature piping and equipment shall be selected to provide maximum 135F outer surface temperature.
- F. Flashing:
1. Provide flashing at jacket penetrations and terminations. Provide clearance for flashing between insulation system and piping supports.
 2. Trowel a heavy tack coat of sealant over the insulation, extending it over the jacket edge 1-inch and over the pipe or protrusion 2-inches. Stretch reinforcement over the tack coat after clipping to fit over pipe and jacket. Strap clipped reinforcing with a continuous band of reinforcing to prevent curling. Then trowel sealant over the reinforcement to a minimum thickness of 1/8 inch.
 3. Form aluminum caps to fit over the adjacent jacketing and to completely cover coated insulation. Hold cap in place with a jacket strap.

END OF SECTION

SECTION 15265

ELECTRIC HEAT TRACE PERFORMANCE

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies minimum standards and guidelines for design and provision of a complete , fully-functional, and tested electric heat trace and control system for protection of piping and tanks including final design, permitting, supervision, and installation by a qualified firm specializing in heat trace design and installation.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
NEMA ICS 1	Industrial Control and Systems: General Requirements

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Product technical data:
 - 1. Power requirements for each circuit based upon actual length of heat trace and maintained temperature.
 - 2. Circuit breaker rating based upon inrush current at minimum expected start-up temperature.
 - 3. Length of heat trace for each pipe size and run.
 - 4. Type of heat trace for each pipe size and run.
 - 5. Length and type of heat trace for each tank or equipment.
 - 6. Temperature setpoint for each thermostat and run.
 - 7. Classification rating for each run.
 - 8. Coordinate and verify length and Watts/FT of heat trace required based upon pipe size and insulation thickness.
 - 9. Provide technical in schedules.
- C. Heat trace sizing and application calculations for each pipe and tank to be heat traced performed by a Professional Engineer in the state of Washington.
- D. Fabrication drawings.
- E. Layout drawings showing the locations of heat trace system equipment, devices, components and accessories.
- F. Wiring diagrams showing physical locations of thermostats and heat trace power supply.
- G. Certification that heat trace can withstand temperature specified herein.
- H. Operation and maintenance information: Section 01730.
- I. Annotated panelboard schedules showing heat trace circuits and circuit breaker sizes.

1.04 CONTRACTOR RESPONSIBILITY

- A. Design and provide complete fully-functional electric heat trace and control system for protection of piping and tanks. Heat trace system includes: circuit breakers, conduit, conductors, heat trace, thermostats, insulation, and controls.
- B. Annotate the drawings identifying areas required by this Contract to have a heat trace system.
- C. Be responsible for obtaining governing authority permits, approval, inspection, and certification of the entire heat trace system and for meeting the requirements of this Section.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Thermon.
- B. Chemelex Division, Raychem Corp.
- C. Chromolox.
- D. Approved Equal.

2.02 GENERAL REQUIREMENTS

- A. Work includes the design and provision of cable and raceway systems to support the heat trace system.
- B. Conduits and wiring among heat trace, thermostats and panels shall be supplied, installed, and tested by the Heat Trace System Installer.

2.03 MATERIALS

- A. General:
 - 1. Heat trace shall consist of self-limiting, parallel circuit construction with a continuous inner core of conductive material between two copper bus wires.
 - 2. The resistance and heating capacity of the heating material shall vary in response to piping temperature changes.
 - 3. Heat trace shall withstand continuous exposure to 150 degree F temperature.
 - 4. Heat trace shall operate using 120 volt AC, single-phase, 60 Hz power.
 - 5. Heat trace shall be provided with copper shield and fluoropolymer jacket.
 - 6. Heat trace type will be selected by the Contractor and supporting calculations provided by a Professional Engineer licensed in the state of Washington as part of the submittals.
 - a. TYPE 1: Type 1 heat trace shall have a thermal rating of 4 watts per foot at 50 degrees F.
 - b. TYPE 2: Type 2 heat trace shall have a thermal rating of 8 watts per foot at 50 degrees F.
 - c. TYPE 3: Type 3 heat trace shall have a thermal rating of 12 watts per foot at 50 degrees F.

2.04 DESIGN PARAMETERS

- A. Pipe diameter, length and material: See this Section, Drawings and relevant piping Specifications.
- B. Flange, valve, pipe support size: See Drawings and relevant piping Specifications.
- C. Pipe insulation type and thickness: See Drawings, Section 15260, and other relevant piping Specifications.

- D. Temperatures requirements:
 - 1. Low ambient temperature for the specific location: 0 degrees F.
 - 2. Start-up temperature (alarm thermostat set point):
 - a. Water/wastewater lines: 40 degrees F.
 - b. Caustic and coagulant lines and tanks: 50 degrees F.
 - 3. Maintain temperature (power thermostat set point):
 - a. Water/wastewater lines: 40 degrees F.
 - b. Caustic and coagulant lines and tanks: 50 degrees F.
 - c. Hot water and hot water return lines: 140 degrees F.
 - 4. High temperature exposure with power off: 140 degrees F.
- E. Wind factor for the specific location: 10 MPH.
- F. Electrical requirements:
 - 1. Voltage: 120 V.
 - 2. Circuit breaker: 20A GFEPCL type or as required.
- G. Safety factor: 10 percent.
- H. All necessary or required components and accessories, such as power connection boxes, lighted end seals, straps, tape and fitting brackets.
- I. In noncorrosive and nonhazardous locations, insulation shall be Polyolefin.
- J. In corrosive, hazardous and hydrocarbon locations insulation shall be Fluoropolymer (Teflon).

2.05 CONTROL THERMOSTATS

- A. General:
 - 1. Thermostats adjustable between 35 and 200 degrees F minimum with maximum differential range of 9 degrees F, furnished complete with NEMA 4 enclosures in all areas (except NEMA 7 in Class I, Div 2 and Class I, Div 1 areas), stainless steel temperature bulb and capillary.
 - 2. Each length of heat trace shall be provided with signal lights wired to the terminating end. A green light shall indicate that the heat trace is ready and a red light, energized.
- B. Type A Thermostat: Type A thermostat shall control by sensing ambient temperature with the following characteristics:
 - 1. Rating: 22 amperes at 120 AC.
 - 2. Control temperature range: 15 to 140 degrees F.
 - 3. Calibration tolerance: two degrees F.
 - 4. Sensor material: stainless steel.
 - 5. Exposure temperature: -65 to 150 degrees F.
 - 6. Temperature setting: 50 degrees F, for freeze protection.
- C. Type B Thermostat: Type B thermostat shall control by sensing pipe temperature with the following characteristics:
 - 1. Rating: 22 amperes at 120 AC.
 - 2. Control temperature range: 25 to 225 degrees F.
 - 3. Calibration tolerance: one percent of full scale.
 - 4. Bulb and capillary material: stainless steel.
 - 5. Control exposure temperature: -65 to 225 degrees F.
 - 6. Sensor over-range temperature: 325 degrees F maximum.
 - 7. Temperature setting:
 - a. 140 degrees F for hot water.
 - b. 60 degrees F for tepid water.
 - c. 50 degrees F for NaOH.

d. 50 degrees F for Coagulant.

2.06 HEAT TRACE SCHEDULE

A. Provide piping heat trace in accordance with the following schedule:

Piping Designation	Location/Service	Piping diameter (inches)	Pipe Material	Service	Thermostat type*
1-1/2"C2	Regulator	1.5	PVC	C2	A
1/4"C2	IPS, EQ & Screening	0.25	Copper	C2	A
1/2"C2	IPS, EQ & Screening	0.50	Copper	C2	A
3/4"C2	IPS, EQ & Screening	0.75	PVC	C2	A
1"C2	IPS, EQ & Screening	1	Copper	C2	A
1 1/2"C2	IPS, EQ & Screening	1.5	PVC	C2	A
2"C2	IPS, EQ & Screening	2	PVC	C2	A
3"C2	IPS, EQ & Screening	3	Steel	C2	A
4"C2	IPS, EQ & Screening	4	Steel	C2	A
1"C2	Caustic Tank	1	Copper	C2	A
1"C2	Coagulant Tank	1	Copper	C2	A
1"C2	Ballasted Sedimentation	1	Copper	C2	A
1-1/2"C2	Ballasted Sedimentation	1.5	PVC	C2	A
2"C2	Ballasted Sedimentation	2	PVC	C2	A
2-1/2"C2	Ballasted Sedimentation	2.5	PVC	C2	A
4"C2	Ballasted Sedimentation	4	Steel	C2	A
1"C2	UV disinfection	1	Copper	C2	A
1 1/2"C2	UV disinfection	1.5	PVC	C2	A
2"C2	UV disinfection	2	PVC	C2	A
4"C2	UV disinfection	4	Steel	C2	A
1"C2	Solids Holding Tank	1	Copper	C2	A
1-1/2"C2	Solids Holding Tank	1.5	PVC	C2	A
2"HW	UV Distribution/Ballasted Sedimentation	2	Copper	HW	B
2"HWR	UV Distribution/Ballasted Sedimentation	2	Copper	HWR	B
2"HW	Caustic Storage	2	Copper	HW	B
2"HWR	Caustic Storage	2	Copper	HWR	B
2"HW	Coagulant Storage	2	Copper	HW	B
2"HWR	Coagulant Storage	2	Copper	HWR	B
1-1/2"HW	Caustic Storage	1.5	Copper	HW	B
1-1/2"HW	Coagulant Storage	1.5	Copper	HW	B
2"C1	Caustic Storage	2	Copper	C1	A
2"C1	Coagulant Storage	2	Copper	C1	A
1-1/2"C1	Caustic Storage	1.5	Copper	C1	A
1-1/2"C1	Coagulant Storage	1.5	Copper	C1	A
6"RS	IPS, EQ & Screening	6	Steel	RS	A
1"D	IPS, EQ & Screening	1	PVC	D	A
8"C3	Ballasted Sedimentation	6	Steel	C3	A
2"NaOH	Caustic Storage	2	CPVC	NaOH	B
1/2"NaOH	Ballasted Sedimentation	0.5	CPVC	NaOH	B
2"COAG	Coagulant Storage	2	CPVC	COAG	B
1/2"COAG	Ballasted Sedimentation	0.5	CPVC	COAG	B
1"DF	Ballasted Sedimentation	1	CPVC	DF	A

* See electrical area classification Drawings for area classification where heat trace will be installed.

B. Provide heat trace for all pipe routings.

C. The tank manufacturer provides tank heat trace in accordance with the following schedule. See Section 13205:

Equipment No.	Content	Tank Dia (ft)	Tank Material	Thermostat Type	Area Classification Rating	Temp Setpoint (°F)
T854440	Coagulant (ACH 12.2% as Al ³⁺)	12'-0"	XLHDPE	A	unclassified	50
T854450	Caustic (25%)	10'-7"	XLHDPE	A	unclassified	50

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Provide at the following facilities on services indicated. See pipes flowstream identification and mechanical Drawings for pipe routings, and valve and appurtenance configurations.

B. Insulate and heat trace pipe systems and tanks as indicated in the Drawings, and in this Specification.

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

1. Each circuit shall not exceed the manufacturer's recommended maximum length.

D. For Metallic Piping:

1. Heat tracing shall be installed completely wired.

2. Cut heat trace to lengths as required and secure to pipe with glass or polyester fiber tape.

E. For Nonmetallic Piping:

1. Allow for extra heat trace output because nonmetallic pipe has a lower heat transfer.

a. Heat tracing shall be installed completely wired.

2. Cut heat trace to lengths as required and secure to pipe with aluminum tape through out the length of the trace.

F. Protection and Control Requirements:

1. Protection by a GFEPCL circuit breaker.

a. Breaker amperage rating shall be coordinated with manufacturer.

2. Thermostats:

a. Type A: Provide an ambient sensing thermostat for power and line sensing thermostat for alarm.

b. Type B: Provide two line sensing thermostats, one for power and one for alarm.

3. The alarm thermostat shall be placed on the opposite end of the circuit from the power thermostat or power connection to allow for annunciation of partial failure of a circuit or the loss of power from a tripped GFEPCL circuit breaker.

G. Fasten heat trace to pipe and valves as recommended by the manufacturer at intervals not exceeding one foot.

H. Provide insulation in accordance with Section 15260 over the heat trace.

3.02 TESTING

- A. Megger the cables at the manufacturer's recommended voltage level three times.
 - 1. Before installation.
 - 2. After attachment to pipe but before insulation is installed.
 - 3. After pipe insulation is installed but before energization.

END OF SECTION

SECTION 15330

AUTOMATIC SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies automatic sprinkler systems for fire protection purposes including requirements for design, obtaining permits, provision of materials and installation in accordance with or exceeding fire protection engineering standards.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
NFPA 13	Standard for the Installation of Sprinkler Systems
SBC	Seattle Building Code
SFC	Seattle Fire Code
UL 199	Automatic Sprinklers for Fire Protection Service
UL 262	Fire Service Water Control Valves
FM 3-26	FM Global Property loss Prevention Datasheet 3-26, Fire Protection Water Demand for Nonstorage Sprinklered Properties

- B. Requirements of Regulatory Agencies: The automatic sprinkler system shall conform to the requirements of City of Seattle:
1. City of Seattle, Local Authority having Jurisdiction.
 2. NFPA 13.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Fire Protection Sprinkler system piping design and layout for reviews, permits and approvals to:
1. Project Representative.
 2. FM Global.
 - a. Include working drawings, sprinkler system hydraulic calculations, earthquake bracing calculations and proposed fire protection equipment.
 - b. Submittal review time: 45 days.
 3. City of Seattle, Local Authority Having Jurisdiction [LAHJ].
- C. Final shop drawings: Stamped approved by the City of Seattle, Fire Marshal's Department
- D. Acceptance test records and test certificates signed and approved by the City of Seattle, LAHJ.
1. Fire Marshal's Department approvals shall be submitted.
 2. The test reports shall include Contractor's material and test certificate for above ground piping and main piping as described in NFPA 13.
- E. Complete hydraulic calculations, including flow test of the system pipe sizing procedure shall be submitted following approval of the City of Seattle, LAHJ Fire Marshal's Department.

- F. Catalog and technical data of sprinkler system components including, fire valves, check valves, fire department connection, sprinkler heads, flow alarm, alarm bell, and compressed air control system.
- G. Spare Parts: Section 01750.

1.04 DEFINITIONS OF SPRINKLER SYSTEM TYPES

- A. Wet Pipe System: A sprinkler system employing automatic sprinklers attached to a piping system containing water and connected to water supply system so that water discharges immediately from sprinklers opened by heat from a fire.

1.05 DESIGN AND PERFORMANCE REQUIREMENTS:

- A. Occupancy classifications for this specification shall be for sprinkler systems design criteria and installations and their water supplies only, in accordance with NFPA 13. They shall not be construed to specify a general classification of occupancy hazards. Provide sprinkler systems to comply with the following:

Building or Area	Occupancy Type	Sprinkler System Hydraulic Density gpm/sq.ft.	Sprinkler System Type
O&M Building, except Electrical Room, Shop and Shop Mezzanine Equipment Room.	Business (B), Factory Industrial (F-2), Storage (S-2)	Light Hazard, 0.10 gpm/sq.ft.	Wet Pipe System
O&M Building Shop	Factory Industrial (F-2)	Ordinary Hazard Group 2, 0.2 gpm/sq.ft.	Wet Pipe System
O&M Building Shop Mezzanine Equipment Room.	Factory Industrial (F-2)	Ordinary Hazard Group 1, 0.2 gpm/sq.ft.	Wet Pipe System
O&M Building Electrical Room	Factory Industrial (F-2)	Not sprinklered.	N/A.

- B. Design Hydrant Flow Information:
 1. Verify zone and data with the Seattle Public Utilities prior to submitting documents for permit.
 2. Date: October 16, 2016.
 3. Hydrant Location: Hydrant 314 S Michigan St – E26.
 4. Water main size: 12 IN.
 5. Water main material: DI.
 6. Pressure zone: S0326.
 7. Static pressure: 131 PSI.
 8. Residual pressure 40 PSI.
 9. Hydrant flow capacity @ residual Pressure: 1690 GPM.
 10. Hydrant capacity @ 20 PSI: 1890 GPM.

1.06 WORKING PLANS

- A. Working drawings shall be easily duplicated and readable after duplication.
- B. When drawings are prepared using computer-aided drafting (CAD), drawings shall be provided in electronic format (CD-R) and on both half and full size prints. Electronic format shall be AutoCAD 14 or later.

- C. Working plans shall be drawn to an indicated scale, on 22-inch by 34-inch sheets, and shall show the following data:
1. Name of owner and occupant.
 2. Location, including street address.
 3. Point of compass.
 4. Ceiling construction.
 5. Location of fire walls.
 6. Location of partitions.
 7. Full height cross section.
 8. Occupancy of each area or room.
 9. Location and size of concealed spaces and closets.
 10. Any questionable small enclosures in which no sprinklers are to be installed.
 11. Size of water main, pressure and distance to nearest circulating main, and main test results.
 12. Sources of water supply, with pressure and elevation.
 13. Make, type and nominal orifice size of sprinklers.
 14. Temperature rating and location of high temperature sprinklers.
 15. Total area protected by each system on each floor.
 16. Number of sprinklers on each riser per floor.
 17. Location of alarm bells.
 18. Pipe type and schedule of wall thickness.
 19. Nominal pipe size and cutting lengths of pipe (or center to center dimensions).
 20. Location and size of riser nipples.
 21. Type of fittings and joints and location of all welds and bends.
 22. Type and locations of hangers and sleeves.
 23. All control valves, check valves, drain pipes and test pipes.
 24. Water main pipe size, length, location, weight, material, point of connection to main and the type of valves, and the pipe anchor system.
 25. Provision for flushing and complete drainage of the system.
 26. For hydraulically designed systems, the material to be included on the hydraulic data nameplate.
 27. Name and address of Contractor.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Sprinklers, Alarm Valves, Deluge Valves, and Alarm and Supervisory Devices:
1. Tyco.
 2. Reliable.
 3. Star.
 4. Viking.
 5. Approved Equal.
- B. Valves, Check Valves, and Indicating Devices:
1. Grinnell.
 2. Hammond.
 3. Stockham.
 4. Approved Equal.

2.02 MATERIALS AND EQUIPMENT FEATURES

- A. Equipment Schedule:

Equipment No.	Description
Fire Valve	V854966
Back Flow Preventer	BV854966

- B. Fire Sprinkler Heads:
1. Upright: Upright sprinkler heads shall be rough brass, polished brass, or chrome plated.
 2. Upright heads shall be standard 1/2-inch orifice with cast brass frame. Heads shall be spray type with solder type fusible link and brass deflector.
 3. Pendant: Pendant sprinkler heads shall be 1/2-inch orifice with cast brass frame. Pendant heads shall be spray type with solder type fusible link and brass deflector. Finish shall be rough brass, polished brass, or chrome plated.
 - a. Unless otherwise indicated, pendant heads installed exposed, below a finished ceiling, shall have chrome plated finish.
 - b. Pendant heads used for semi-recessed sprinkler locations shall be chrome-plated finish. Escutcheon plates shall be provided for all pendant sprinkler heads at finished ceilings.
 4. Sprinkler heads shall have a minimum K-factor of 8.0, shall be FM approved, and shall be rated for 160 DegF.
- C. Alarm Check Valve:
1. Alarm check valve shall be UL listed, FM approved water flow alarm check valve which lifts from its seat when water flows.
 2. Check valve shall be provided complete with clapper, external bypass valve, alarm test bypass, pressure gage, drain connections, mounting supports for the retarding chamber, and a drip funnel.
 3. A retarding chamber shall be provided for varying water pressure as conditions require.
 4. Special alarm trimming for sending an electric alarm signal to the building fire alarm panel shall be provided.
- D. Flow Switch: A water flow switch which either opens or closes an electrical signal circuit upon constant flow of water through the system shall be provided. Switches shall be snap action, tamper proof, and have adjustable time response from 0 to 90 seconds.
- E. Test Station: An approved valve and drain system shall be provided to test operation of alarm devices. The test station shall be 1-inch pipe and the termination shall be 1/2-inch orifice size nozzle. The test station shall drain to the outside of the building.
- F. Alarm Bell: An electrically driven, 10-inch-diameter round, red enamel finish, steel bell shall be provided for use with flow switches and supervisory devices. The alarm bell shall be weatherproof for exterior mounting.
- G. Gauges:
1. Pressure gauges shall be UL listed and labeled for fire protection sprinkler service, minimum 3 1/2 inch dial, moisture proof and weather resistant, 0-300 psi scale, 5 psi increments. Each gauge shall be fitted with a three-way valve and a 1/4 inch threaded test connection.
- H. Fire Department Connection:
1. An approved fire department connection, of the same size as the system riser, shall be provided on the system side of the alarm check valve.
 2. A cast brass, single straight outlet fire department hose connection shall be provided at the exterior of the building wall, near the system riser.
 3. The hose connection shall be 2-1/2 inch pipe size, with internal threaded outlet having threads compatible with those of the (specify the City) Fire Department.
 4. The hose connection shall be provided complete with brass clapper, brass threaded plug and chain.
 5. The fire department hose connection shall be provided with a brass wall escutcheon labeled "AUTO. SPRINKLER".
 6. The fire department connection shall be provided with an approved check valve and an automatic drip type drain valve in the piping between the hose connection and the system riser connection.

- I. Valves: Valves in water supplies and supply pipes shall be provided with approved indicating means. Valves shall not close in less than 5 seconds when operated at maximum possible speed from the fully open position. Valves shall be iron body, bronze trim, gate valves, 175 psi working water pressure rated, Underwriters Laboratory labeled for the application in which they are used. Above ground valves shall be OS&Y type unless otherwise specified.
- J. Hangers and Supports for Piping: Pipe hangers shall be made of ferrous materials, unless otherwise approved, and shall be listed. Portions of the building structure used to support the system shall be designed to support the weight of water-filled pipe plus 250 pounds. Hanger type and minimum sizes shall be as specified by NFPA 13. Maximum support spacing shall be as specified in NFPA 13. Seismic bracing shall be provided on sprinkler piping for seismic criteria listed in Section 01031.

2.03 ACCESSORIES

- A. NFPA approved identification signs shall be provided for valves and the sprinkler alarm. Each valve identification sign shall indicate the portion of the system controlled by the particular valve.
- B. The sprinkler alarm shall have a sign stating "SPRINKLER FIRE ALARM", "When bell rings call 911, fire department, or police."

2.04 SPARE PARTS

- A. Procedures: Section 01750.
- B. The Contractor shall provide a minimum of 12 sprinklers as required by NFPA 13. The sprinklers shall be spares of each type and temperature rating installed. The sprinklers shall be provided in a red enamel finished, steel cabinet with identification saying "EXTRA FIRE SPRINKLER HEADS", sized to hold the number of sprinklers required.

PART 3 EXECUTION

3.01 WORKING PLANS CERTIFICATION

- A. Obtain permit from LAHJ Fire Marshal before any equipment is installed.
- B. The submitted drawings shall comply with working drawing requirements as specified in NFPA 13 and this Section.

3.02 PRE-INSTALLATION CONFERENCE

- A. Prior to the installation of fire sprinkler piping, set up and conduct a pre-installation conference attended by the Contractor and other subcontractors involved in the project. At this time, identify and make any necessary adjustments to the fire protection piping layouts to avoid conflicts with other trades.

3.03 INSTALLATION

- A. Alarm Devices: Install alarm devices where specified and as recommended by the manufacturer. The Contractor shall provide piping, wiring and relays to operate alarm bell from the alarm check valve and for alarm system connection to the building's fire alarm panel, PNL 854966.
- B. Test Stations: The Contractor shall provide test stations to each alarm device and individually test each item required by NFPA 13. Drain water from the test stations to the outside.

- C. Valves:
 - 1. Install valves and accessories in accordance with manufacturer's instructions.
 - 2. Locate valves to individually isolate building systems and to maintain proper flow and functions of the systems.
 - 3. Provide shutoff valve operation security as required by the Fire Marshal.

- D. Sprinklers:
 - 1. Install sprinklers throughout all areas indicated in the Drawings.
 - 2. Maximum protection area per sprinkler shall be in accordance with occupancy required in the building served.
 - 3. Avoid interferences with sprinkler discharge pattern by beams, bracing, girders, trusses, piping, lighting fixtures, ductwork, etc.
 - 4. Adjust location of sprinklers to accommodate ceiling tile grids and beams, centering sprinklers on architectural features in finished areas if code spacing requirements do not dictate otherwise.

- E. Piping and Hangers:
 - 1. Sprinkler main locations indicated in the Drawings are approximate. Verify exact location before installing piping.
 - 2. Branch lines shall be provided above cross mains and cross mains shall be above feed mains in order to allow complete drainage of the system.
 - 3. Piping shall be supported independently of ceiling sheathing and substantially supported by building structure.
 - 4. Unless otherwise indicated, provide a minimum of one hanger for each pipe length. Maximum distance between hangers shall be as required by NFPA 13.
 - 5. Risers shall be supported by attachment directly to the riser or by hangers at horizontal connections close to the riser. Spacing of riser supports shall be as required by NFPA 13.
 - 6. Provide seismic and sway bracing on all sprinkler systems in accordance with Section 01031 and NFPA 13 requirements.

- F. Sleeves and Escutcheons:
 - 1. Provide sleeves for all pipes passing through slabs, walls and partitions. Sleeves shall extend 3 inches above floor and flush with the walls. Sleeves shall be set in forms prior to concrete pour for new concrete walls.

3.04 FIELD QUALITY CONTROL

- A. Flow Test:
 - 1. Conduct a flow test on the water main supplying the sprinkler system to determine static and residual pressures available.
 - 2. Use the results of the flow test as the basis for sprinkler system sizing in hydraulically designed systems and submit these results to the LAHJ for approval with the calculations.
 - 3. Conduct the flow test under maximum domestic consumption conditions.
 - 4. The test hydrant used for static and residual pressure readings shall be located as close as possible to the fire protection system tap location.

- B. Hydrostatic Test:
 - 1. Hydrostatically test the entire sprinkler system following installation.
 - 2. Hydrostatically test the system at not less than 200 psi or 50 psi above maximum static pressure of the system, whichever is greater, for a minimum of 2 hours.
 - 3. No visible leakage from the system shall be permitted.
 - 4. Following completion of the test, fill out test certificates and obtain approval of the LAHJ.

END OF SECTION

SECTION 15400

PLUMBING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies drains, piping, appurtenances and general requirements for plumbing systems.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
SPC	Seattle Plumbing Code
ASTM D1785	Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

- B. Work shall be in accordance with the Seattle Plumbing Code as adopted and/or modified by the Local Authority Having Jurisdiction.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Catalog data and installation details for all plumbing equipment.

PART 2 PRODUCTS

2.01 CLEANOUTS

- A. General:
 - 1. Unless otherwise indicated, cleanouts shall be the same size as the pipe connected.
 - 2. Provide cleanouts with clamping collars where waterproofing membranes are located in the floor.
 - 3. Provide cleanouts located inside buildings with nickel-bronze covers.
 - 4. Provide bronze plug with tapered thread for cleanouts on pressurized systems.
 - 5. Cleanouts on chemical waste or drain lines shall be of the same material and type of joint as the pipe.
 - 6. Provide floor drain trap sealers with drains that directly connect two separate rooms/spaces.
- B. Acceptable Manufacturers:
 - 1. Type I Cleanout:
 - a. Josam series 56010.
 - b. J. R. Smith series 4020.
 - c. Approved Equal.
 - 2. Type II Cleanout:
 - a. Josam series 56010(-12).
 - b. J. R. Smith series 4140.
 - c. Approved Equal.

3. Type III Cleanout:
 - a. Josam series 58500 (-20).
 - b. J. R. Smith series 4420.
 - c. Approved Equal, with cast iron frame and cover as indicated in the Drawing details.
4. Type IV Cleanout:
 - a. Josam series 58500(-20).
 - b. J. R. Smith series 4420.
 - c. Approved Equal.
5. Type V Cleanout:
 - a. Josam series 58890.
 - b. J. R. Smith series 4472.
 - c. Approved Equal.

C. Chemical cleanouts: Cleanouts on chemical waste or drain lines shall be Duriron or material equal to that used for the pipelines and piping fittings.

2.02 DRAINS

A. Floor Drains:

1. General: Provide floor drains with clamping collars where waterproofing membranes are located in the floor.
2. Acceptable Manufacturer:
 - a. Type I Floor Drain:
 - 1) Josam series 32130.
 - 2) J. R. Smith series 2225.
 - 3) Approved Equal.
 - b. Type II, III, and IV Floor Drains:
 - 1) Josam series 32120.
 - 2) J. R. Smith series 2220.
 - 3) Approved Equal.
 - c. Type V Floor Drain:
 - 1) Josam series 30000-A.
 - 2) J. R. Smith series 2010-A.
 - 3) Approved Equal.
 - d. Type VI Floor Drain:
 - 1) Josam series 49580 (-31).
 - 2) J. R. Smith series 3066.
 - 3) Approved Equal.

B. Condensate Drains: Unless otherwise specified, condensate drains shall be as specified for piping system 24 in Section 15050.

C. Rain drains:

1. Acceptable Manufacturer:
 - a. J. R. Smith series 1020.
 - b. Josam.
 - c. Approved Equal.

D. Boot wash drains:

1. Acceptable Manufacturer:
 - a. J. R. Smith series 3060.
 - b. Josam series 49290 (-31).
 - c. Approved Equal.

E. Equipment drains: Of the design shown on the mechanical general detail sheet.

- F. Parapet drains: Unless otherwise indicated, parapet drains shall be Josam series 24700.
- G. Chemical drains: Drains on chemical waste or drain lines shall be Duriron or material equal to that used for the pipelines and piping fittings.
- H. Laboratory drains:
 - 1. Duriron high silicon acid resisting type or of equal material to that of the laboratory pipelines and fittings.
 - 2. P-trap shall be tempered glass swivel split drum Duriron, or Approved Equal.

2.03 FLOOR DRAIN ACCESSORIES

- A. Floor drain trap sealers:
 - 1. Commercial grade UV and Ozone resistant ABS plastic housing and rubber diaphragm.
 - 2. Soft rubber sealing gasket.
 - 3. Size as required for drain.
- B. Acceptable Manufacturer:
 - 1. Rectorseal SureSeal.
 - 2. Proset.
 - 3. Approved Equal.

2.04 VALVE ACCESSORIES

- A. Access Covers:
 - 1. Access covers for concealed valves within structure interiors shall be 12 inches by 12 inches minimum, stainless steel.
 - 2. Acceptable Manufacturers:
 - a. J. R. Smith series 4762 or 4767.
 - b. Karp 214-M or 214-P.
 - c. Approved Equal.
- B. Provide 2 keys or wrenches for each type of key-operated valve.
- C. Adjustable shaft valve boxes:
 - 1. Box covers on water lines shall be impressed with the letter "W."
 - 2. Acceptable Manufacturers:
 - a. Brooks No. 3 RT.
 - b. Christie G5.
 - c. Approved Equal.

2.05 COUPLINGS, NIPPLES AND UNIONS

- A. Couplings and nipples shall be of the same material as the pipe on which they are used.
- B. Unions: See Section 15085.

2.06 WATER HAMMER ARRESTERS

- A. Welded bellows type, all stainless steel construction. Zurn Shoktrol, Jay R. Smith Hydrotrol or Approved Equal.

P.D.I. Size	Zurn Shocktrol	Jay R. Smith Hydrotrol
A	Z-1700-100	5005

P.D.I. Size	Zurn Shocktrol	Jay R. Smith Hydrotrol
B	Z-1700-200	5010
C	Z-1700-300	5020
D	Z-1700-400	5030
E	Z-1700-500	5040
F	Z-1700-600	5050

2.07 SLEEVES

- A. Sleeves shall be 22-gage sheet metal.

2.08 ESCUTCHEONS

- A. Escutcheons shall be chrome-plated cold rolled steel or stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General:
 1. Work shall be in accordance with the Seattle Plumbing Code.
 2. Provide plumbing to avoid obstructions, allow 7.5 feet minimum headroom, and keep openings and passageways clear.
 3. Make no holes in structural members.
 4. Repair torn and pierced waterproofing.
 5. Wrap fixtures, fittings, valves, and copper and brass items with burlap or building paper. Remove wrapping at completion of the Work.
 6. Floor drain directly connected to the drainage system and subject to infrequent use shall be protected with a floor drain trap sealer.
- B. Valves and Accessories:
 1. Provide valves upstream of branches, apparatus and fixtures.
 2. Provide valves on branch lines and at distribution points with a 2-inch heavy brass disc, stamped and stencil with 1/4-inch high letters, stating portion of system controlled by valve.
 3. Valve locations shall be shown on record drawings. Provide a chart of location and use of main valves.
 4. Provide adjustable shaft valve boxes for underground valves.
- C. Dielectric Unions: Provide dielectric unions at connections between pipe or fittings of different material.
- D. Escutcheons: Provide escutcheons where pipes penetrate finished walls, ceilings or floors. Securely mount escutcheons allowing clearance for expansion.
- E. Piping:
 1. Carry piping in chases or recesses where provided in walls, through floors and partitions, and over ceilings. Unless otherwise indicated, do not run piping in floor slabs.
 2. Do not support pipes by plumbing fixtures or equipment.
 3. Make changes in pipe size with reducing fittings. The use of bushings is not acceptable.
 4. Where galvanized steel pipe is caulked into a cast iron hub, provide a soil pipe adapter on the caulked end of the steel pipe.
 5. Unless otherwise indicated, underground piping outside buildings shall have a minimum cover of 24 inches. Piping under buildings shall have a minimum clearance from structure of 12 inches.

6. Separate hot and cold water piping by at least 6 inches.
7. Provide pipe anchors, guides, supports and hangers, and seismic restraints in accordance with Section 15090, Section 15096, and Section 15097.
 - a. Down spout and rain leader design shall comply with the details indicated in the Architectural Drawings.

3.02 CLEANING AND FLUSHING

- A. Clean and flush piping and equipment in accordance with Section 15050.

END OF SECTION

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SECTION 15440
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies plumbing fixtures, trim, and fittings.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
SPC	Seattle Plumbing Code
H.U.D.	US Department of Housing and Urban Development
ANSI A112.19.2	Ceramic Plumbing Fixtures
ASME A112.19.1	Cast Iron Plumbing Fixtures
ASME A112.19.3	Stainless Steel Plumbing Fixtures
ASHRAE 90-75	Energy Conservation in New Building Design

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Operations and maintenance information: Section 01730.
- C. Manufacturer's catalog data.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment No.	Description	Type
WH854569	Hot Water System Water Heater	Natural gas fired tank style
WH854976	Domestic Water Heater	Natural gas fired tank style
P854569	Re-circulating Pump	In-line pump
P854976	Re-circulating Pump	In-line pump

2.02 LAVATORY

- A. Acceptable Manufacturers, lavatory:
 - 1. American Standard.
 - 2. Kohler.
 - 3. Eljer.
 - 4. Approved Equal.

- B. Acceptable Manufacturers, faucet:
 1. American Standard.
 2. Chicago Faucet.
 3. Sloan.
 4. Approved Equal.

- C. Lavatory:
 1. White vitreous china or enameled cast iron.
 2. 19 IN by 17 IN.
 3. Front overflow.
 4. Wall hung.
 5. Wheelchair accessible.
 6. Conform to ANSI Standard A112.19.2.
 7. 8 IN center.

- D. Faucet:
 1. Deck mount.
 2. Chrome plated brass.
 3. 8 IN. Centers
 4. 5 IN gooseneck spout.
 5. 4 IN lever handles
 6. 1.5 GPM.
 7. ADA and ANSI A117.1 compliant.

- E. Accessories/Trim:
 1. Concealed arm type fixture carrier.
 2. Chrome plated cast brass strainer with 1-1/4 IN OD copper tube tailpiece, chrome plated P-trap with cleanout and copper tube trap arm.
 3. Loose key stops, copper tube supply, chrome escutcheon.

2.03 STAINLESS STEEL BOWL SINKS

- A. Acceptable Manufacturers, sink:
 1. Just Manufacturing.
 2. Elkay.
 3. Approved Equal.

- B. Acceptable Manufacturers, faucet:
 1. American Standard.
 2. Chicago Faucet.
 3. Approved Equal.

- C. Kitchen Sinks:
 1. Type 304, 18-8 stainless steel, 18 GA minimum.
 2. Under mount installation.
 3. zSound deadening pad/spay sides and bottom.
 4. 30.5 IN by 18.5 IN Single bowl.
 5. 5.5 IN maximum bowl depth.
 6. Drain 5 IN from back of sink.
 7. ADA compliant.
 8. Basket strainer and tailpiece.
 9. ASME A112.19.3.
 10. 3 holes – 4 IN centers.

- D. Faucet:
 1. Bottom mounted.
 2. 8 IN spread with 6 IN wristblade handles.
 3. 8 IN diameter swing gooseneck.
 4. 1.5 GPM pressure compensating aerator.
- E. Accessories/Trim:
 1. Chrome plated brad drain body with chrome plated brass removable basket strainer, neoprene stopper with chrome plated metal slide post for 3-1/2 IN outlet and 1-1/2 IN copper tube tailpiece.
 2. Chrome, 1-1/2 IN semi-cast P-trap with cleanout with 17 GA x 1-1/2 IN OD copper tube trap arm.
 3. Loose key stops, copper tube supply, chrome escutcheon.

2.04 WATER CLOSET

- A. Acceptable Manufacturers, Water Closet:
 1. American Standard.
 2. Kohler.
 3. Approved Equal.
- B. Acceptable Manufacturers, Flush Valve:
 1. Sloan.
 2. American Standard.
 3. Approved Equal.
- C. Water Closet:
 1. Elongated siphon jet design.
 2. White vitreous china.
 3. Wall mounted.
 4. 1-1/2 IN inlet spud.
 5. Operates in the range of 1.1 GPF to 1.6 GPF.
- D. Flush Valve:
 1. Diaphragm type.
 2. Chrome finished brass.
 3. 13-1/2 IN tall.
 4. Lever operated.
 5. Integral vacuum breaker.
 6. Vandal resistant back-check angle stop.
 7. 1.1 GPF.
- E. Accessories/Trim:
 1. Toilet seat: White, molded plastic, open front, stainless steel hinge, bolts and hardware, no cover.
 2. Fixture carrier: Adjustable for standard height or accessible height installation, floor anchored, coated cast iron. Chrome finish on exposed parts.

2.05 SERVICE SINKS AND MOP SINKS

- A. Acceptable Manufacturers, Service Sinks:
 1. American Standard.
 2. Kohler.
 3. Eljer.
 4. Approved Equal.
- B. Acceptable Manufacturers, Mop Sinks:
 1. American Standard.
 2. Kohler.

3. Florestone.
4. Approved Equal.

C. Acceptable Manufacturers, Faucets:

1. Chicago Faucets.
2. American Standard.
3. Kohler.
4. Approved Equal.

D. Service Sinks:

1. Acid resistant, white enameled cast iron.
2. Stainless steel rim guard.
3. Backsplash without holes.
4. 3 IN outlet.
5. Chrome strainer.
6. Adjustable cast iron P-trap with cleanout plug.
7. Wall hanger.
8. ASME A112.19.1.

E. Mop Sinks:

1. 3 IN outlet.
2. Square drop.
3. 24x24x12.
4. Receptor shall be reinforced with 16 gauge wire.
5. Two-sided tile flange.

F. Faucets:

1. Brass construction.
2. Wall mounted.
3. Two handles.
4. Integral vacuum breaker.
5. 3/4 IN hose threads.
6. Flanged inlets.
7. Integral stops.
8. Pail hook, wall brace.
9. Hose and hose holder.

2.06 WASH STATIONS

A. Acceptable Manufacturers, Wash Stations:

1. Columbia Products.
2. Elkay.
3. Advance Tabco.
4. Approved Equal.

B. Wash Stations:

1. 16 gauge type 304 stainless steel.
2. Outside dimensions: 60x20x18 high.
3. Satin Finish.
4. Three person wash station.
5. Wall mount.
6. Single knee pedal valve (bottom mount).
7. Strainer assembly with basket.
8. Swivel gooseneck spout with 0.5 gpm aerator.
9. Wall mounting brackets.
10. Mixing check valve.

11. Connecting tubes.

2.07 GARBAGE DISPOSERS

- A. Acceptable Manufacturers, Garbage Disposers:
 - 1. In-Sink Erator.
 - 2. General Electric.
 - 3. Approved Equal.

- B. Garbage Disposers:
 - 1. Continuous Feed.
 - 2. ½ hp motor.
 - 3. Galvanized steel grinding elements.
 - 4. Two stainless steel 360 degree swivel lugs.
 - 5. Self service wrench.

2.08 SHOWER FITTINGS

- A. Acceptable Manufacturers, Shower fittings:
 - 1. Symmons.
 - 2. American Standard
 - 3. Kohler
 - 4. Approved Equal.

- B. Fixed shower head and function levers
 - 1. Single function shower head
 - 2. Brass ball joint
 - 3. 2.5 GPM maximum flow rate.
 - 4. Polished chrome finish
 - 5. 2 way in wall Diverter to hand shower
 - 6. Pressure balance shower valve with shut offs for shower head / hand shower
 - 7. In-line vacuum breaker

- C. Hand Showers:
 - 1. Single function hand shower.
 - 2. 5 foot flexible hose with inline vacuum breaker.
 - 3. Wivel wall bracket.
 - 4. Wall connection and flange.
 - 5. 30 inch vertical bar with adjustable slide.
 - 6. 1.5 gpm flow regulator.
 - 7. Polished chrome finish.

2.09 DOMESTIC HOT WATER HEATERS

- A. Acceptable Manufacturers, Domestic hot water heaters:
 - 1. State.
 - 2. AO Smith.
 - 3. Approved Equal.

- B. Domestic hot water heaters:
 - 1. Natural gas-fired tank type.
 - 2. Size and capacity as scheduled in the Drawings.
 - 3. Minimum 95% thermal efficiency.
 - 4. Certified by CSA and bear NSF approval.
 - 5. Concentric vent kits.
 - 6. Provide with flexible gas connection.

2.10 ICE MAKER OUTLET BOXES

- A. Acceptable Manufacturers, Ice Maker Outlet Boxes:
 - 1. Oatey.
 - 2. Approved Equal.
- B. Ice Maker Outlet Boxes:
 - 1. Supply valve recessed into the wall.
 - 2. 1/4 turn brass ball valve.

2.11 WALL HYDRANTS

- A. Acceptable Manufacturers, Wall Hydrants:
 - 1. Woodford.
 - 2. Wade.
 - 3. Approved Equal.
- B. Wall Hydrants:
 - 1. Non-freeze.
 - 2. Anti-siphon vacuum breaker.
 - 3. 3/4 IN hose connection.
 - 4. 3/4 IN inlet connection.

2.12 THERMAL EXPANSION TANKS

- A. In-line type, threaded ends.
- B. Acceptable manufacturers:
 - 1. Watts ILT-5-T.
 - 2. Amtrol.
 - 3. Approved Equal.

2.13 RE-CIRCULATING PUMP

- A. Acceptable Manufacturers, re-circulating pump
 - 1. Bell & Gossett.
 - 2. Approved Equal.
- B. Re-circulating Pump:
 - 1. In-line wet rotor.
 - 2. Lead free bronze.
 - 3. Ceramic shaft supported by carbon bearings.
 - 4. Non-overloading at any point on the pump curve.

2.14 DRINKING FOUNTAIN

- A. Acceptable Manufacturers, drinking fountain
 - 1. Haws.
 - 2. Elkay.
 - 3. Approved Equal.
- B. Drinking Fountain:
 - 1. 18 gauge Type 304 stainless steel swirl design bowl.
 - 2. Hi-Lo wall mounted barrier free.
 - 3. 14 gauge type 304 stainless steel bracket.

4. Vandal resistant bottom plate.
5. Stainless steel back panel.
6. 3/16" steel mounting plate with mounting hardware and support frame.
7. Polished chrome plated brass bubbler head with integral laminar flow.
8. 0.45 GPM.

PART 3 EXECUTION

3.01 GENERAL

- A. Fixtures shall be provided plumb and level. Seal joints between wall and fixtures with silicone sealer, top and sides.
- B. Fixtures shall remain in manufacturer's packaging until installation.
- C. Fixtures shall be provided with required holes for fittings and mounting hardware. Unoccupied fixture faucet holes are not acceptable. Exposed fixture setting bolts shall be fitted with china caps.
- D. Supporting of fixtures:
 1. In accordance with manufacturer's recommendations.
 2. Wall-mounted fixtures shall be provided with brackets and anchorage.
 3. Drop-eared fittings shall be provided at fixture outlets and securely fastened to backing.
- E. Openings into pipes shall be capped during construction.
- F. Vitreous finished surfaces shall have heavy paper pasted thereon during construction.
- G. Water heaters shall be installed in accordance with the manufacturer's recommendations.
- H. Provide water heater with minimum 20 gauge steel, 1 IN wide seismic restraint straps at 1/3 and 2/3 position. Secure to wall with screws.
- I. Sewage ejector piping, electrical, and supports shall be in accordance with the manufacturers' requirements and as indicated in the Drawings.
- J. Provide vent pipe for water closet, service sink, and lavatory, as indicated in the Drawings and required by codes.

END OF SECTION

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SECTION 15442

EMERGENCY EYEWASH AND SHOWER

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies emergency eyewash and shower units for indoor and outdoor use.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/ISEA Z358.1	Emergency Shower and Eyewash Equipment

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's catalog data.
- C. Operation and maintenance information: Section 01730.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment No.	Description	Type of Unit
SFT854401	Polymer Room Eye Wash	Indoor eyewash unit
SFT854445	Coag Feed Room Safety Shower	Indoor wall mounted combination unit
SFT854446	Coag Fill Station Safety Shower	Outdoor combination unit
SFT854447	Coag Storage Safety Shower	Outdoor combination unit
SFT854455	Caust. Feed Room Safety Shower	Indoor wall mounted combination unit
SFT854456	Caust Fill Station Safety Shower	Outdoor combination unit
SFT854457	Caust Storage Safety Shower	Outdoor combination unit
SFT854501	UV Pump Room Safety Shower	Indoor combination unit
SFT854502	UV Deck Safety Shower	Outdoor combination unit
SFT854911	Maintenance Shop Eyewash	Counter mounted interior eyewash

2.02 GENERAL

- A. Emergency eyewash and safety showers shall meet the performance and dimension requirements of ANSI standard Z358.1.

2.03 ACCEPTABLE MANUFACTURERS

- A. Acorn Engineering Company, Inc.
- B. Bradley Corporation.
- C. Guardian Equipment.
- D. Haws Company.
- E. Speakman Company.
- F. Approved Equal.

2.04 EYEWASH AND SHOWER UNITS

- A. Indoor Combination Units:
 - 1. Indoor units shall be emergency shower and eyewash combinations that are floor-mounted and free-standing.
 - 2. Standards: 1-1/4-inch diameter hot-dipped galvanized pipe with cast floor flange.
 - 3. Shower heads: Brass or stainless steel with flow pattern meeting ANSI Z358.1 requirements.
 - 4. Shower valve: One-inch, stay-open ball valve with rigid pull handle.
 - 5. Eyewash bowls: Stainless steel.
 - 6. Eyewash valve: Hand and foot activation of a stay-open ball valve.
 - 7. Eyewash units: Having automatic pressure and volume control and supply line strainer.
 - 8. Provide all units with a flow switch which shall open a contact when flow occurs and rated for 120 volt service.
- B. Indoor Wall Mounted Combination Units:
 - 1. Surface mounted, indoor combination safety shower and eyewash.
 - 2. Cabinet: 18 gauge type 304 stainless steel.
 - 3. Shower head: Stainless steel with flow pattern meeting ANSI Z358.1 requirements.
 - 4. Shower valve: One-inch, stay-open ball valve with pull-down cabinet mounted handle.
 - 5. Eyewash: Stainless steel.
 - 6. Eyewash valve: Pull-down and open cabinet to activate. Stay-open ball valve.
 - 7. Automatic flow and pressure control and supply line strainer.
 - 8. Provide units with a flow switch which shall open a contact when flow occurs and rated for 120 volt service.
- C. Indoor Eye/Face wash Units:
 - 1. Indoor unit shall be wall-mounted emergency eye/face wash station.
 - 2. Eyewash bowls: Stainless steel.
 - 3. Eyewash valve: Hand activated stay-open ball valve.
 - 4. Eyewash unit accessories: Automatic pressure and volume control and supply line strainer.
 - 5. Provide with flow switch which shall open a contact when flow occurs and is rated for 120V service.
- D. Outdoor Combination Units:
 - 1. Outdoor units shall be emergency shower and eyewash combinations which are base-mounted, free-standing, and freeze-proof.
 - 2. Standards: 1-1/4-inch hot-dipped galvanized pipe with cast floor flange.
 - 3. Both eyewash and shower: Having hand-activated panic bars with valves that stay open until manually closed.
 - 4. Shower heads: Brass or stainless steel.
 - 5. Eyewash bowls: Stainless steel.
 - 6. Eyewash units: Having automatic pressure and volume control and supply line strainer.

7. Provide all units with a flow switch which shall open a contact closure when flow occurs and rated for 120 volt service.
 8. 120v thermostatically controlled heat traced cable.
- E. Counter Mounted Interior Eyewash Units:
1. Counter mounted, swing down style eyewash.
 2. Barrier free.
 3. Autoflow 90 degree swing down.
 4. Automatic pressure and volume control.
 5. Swing-down stay-open valve.
 6. Provide all units with a flow switch which shall open a contact closure when flow occurs and rated for 120 volt service.
 7. 1.8 GPM flow control orifices.

2.05 ACCESSORIES

- A. Emergency identification sign for each unit.
- B. Provide each unit with thermostatic mixing valve to blend hot and cold water to deliver tepid water as required by ANSI Z358.1-2014.
1. Where units are located within 20 FT of each other up to two units may be served by a single mixing valve.
- C. Test Equipment
1. One 7-foot long, watertight, 12-gage vinyl plastic bag suitable for testing the emergency showers.
 2. Bag shall have a drawstring at the top for ease of attaching to the shower head and shall be hemmed at the bottom.

PART 3 EXECUTION

3.01 GENERAL

- A. Where shown, provide outdoor and unheated area eyewash and shower units which are located above galleries or rooms and cannot drain to the earth with valving and appurtenances to automatically drain as shown.

END OF SECTION

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SECTION 15509

FIRE HYDRANTS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies fire hydrants. Fire hydrants provided under this Section shall be compression shutoff, dry-barrel, and "Traffic Model" type and be a model approved by the City of Seattle.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
AWWA C502	Dry-Barrel Fire Hydrants
UL 246	Hydrants for Fire-Protection Service

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Affidavit of compliance with AWWA C502.
- C. Records of standard tests.
- D. Spare Parts: Section 01750.

1.04 DESIGN REQUIREMENTS

- A. Fire hydrants shall conform to AWWA C502 and shall be listed by Underwriters Laboratories, Inc. in accordance with UL 246.

1.05 TESTING

- A. Fire hydrants shall meet the factory and field test provisions of AWWA C502.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Clow Medallion.
- B. M&H Style 929.
- C. Mueller Super Centurion 200.
- D. American Darling B62B.
- E. Approved Equal.

2.02 EQUIPMENT

- A. Hydrant:
 - 1. Hydrants shall be the "Traffic Model" type equipped with a center 1-1/4-inch operating nut and shall be designed so that the main valve on the hydrant remains closed should the hydrant nozzle section be broken off by a traffic accident. Main valve opening shall be minimum 5-1/4-inch diameter and water main connection shall be a 6-inch mechanical or flange shoe connection.
 - 2. Hydrants shall have at least two 2-1/2-inch hose ports with caps, which shall have National Standard male threads. The pumper port shall be 4 inches in diameter with Seattle Standard male thread. The pumper port shall be provided with a 4-inch Storz assembly.
- B. Fire Hydrant Adapter Requirements:
 - 1. Fire hydrants shall be supplied with two 14-20 holes drilled and tapped, 180 degrees apart through female thread, to lock adapter to hydrant.
 - 2. Supply and install any required sealants and/or gaskets.
 - 3. Supply two sets of installation tools.
- C. Fire Hydrant Cap Requirements:
 - 1. Provide and install one nitrile/vinyl rubber seal, suction style for zero leakage, color gray.
 - 2. The hydrant shall come equipped with a 1/8-inch diameter cable, either rust proof or vinyl coated, a minimum of 18 inches in length, with compression connections to attach the cap to the hydrant.
 - 3. The force required to connect or disconnect the adapters shall be a minimum of 18 ft/lbs, maximum of 30 ft/lbs.

2.03 PAINTING

- A. Hydrants shall be painted with two coats of high gloss paint suitable for metal application over shop applied primer base coat. Consult with the Local Jurisdiction for the appropriate color of paint application.

2.04 SPARE PARTS

- A. Procedures: Section 01750.
- B. Provide one extra nitrile/vinyl rubber seal, suction style for zero leakage, color gray.
- C. Tag and store standby components as specified in Section 01750.

PART 3 EXECUTION

3.01 GENERAL

- A. Install fire hydrants in accordance with Local Jurisdiction requirements in the locations indicated in the Drawings.
- B. Existing hydrants on pressurized water mains owned by Seattle Public Utilities (SPU) will be relocated by SPU. Coordinate relocation with SPU. Notify Project Representative and SPU twenty-one (21) days prior to needing relocation work completed by SPU.

END OF SECTION

SECTION 15632

ELECTRIC UNIT SPACE HEATERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies electric unit heaters for indoor space heating applications.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
NFPA	National Electrical Code (NEC)
UL 823	Electric Heaters for Use in Hazardous (Classified) Locations
UL 1025	Electric Air Heaters

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's catalog or other data confirming conformance to specified design, material and equipment requirements.
- C. Electrical and control diagrams.
- D. Operation and maintenance information: Section 01730.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment No.	Description	Type
UH854474A	Polymer Room Unit Heater	Wash Down Unit Heater
UH854474B	Polymer Room Unit Heater	Wash Down Unit Heater
UH854376	Sample Room Unit Heater	Explosion Resistant Unit Heater
UH854476	Caustic Room Unit Heater	Wash Down Unit Heater

2.02 GENERAL

- A. Unit heaters shall bear the label of a rating agency recognized in the state of Washington and shall conform to NEC requirements.

2.03 ACCEPTABLE MANUFACTURERS

- A. Chromalox.
- B. Indeeco.
- C. Trane.

- D. Reznor.
- E. Approved Equal.

2.04 CORROSION-RESISTANT ELECTRIC UNIT HEATERS

- A. General:
 - 1. Provide corrosion-resistance electric unit heaters.
 - 2. The heaters shall be provided with built-in controls.
 - 3. The heaters shall be UL-listed and CSA-certified for corrosive areas and NEMA 4X hose –down requirements.
 - 4. The heaters shall be the forced fan type, and of the power and voltage ratings as suitable for electrical distribution system as indicated.
- B. Construction:
 - 1. The heating elements shall be of finned tubular construction and composed of Type 316 stainless steel.
 - 2. Provide stainless steel fittings to form a watertight seal between the elements and the junction box.
- C. Motors:
 - 1. Motors shall be:
 - a. UL-listed.
 - b. CSA-certified.
 - c. Totally enclosed.
 - d. Epoxy painted.
 - e. Provide with permanently lubricated ball bearings.
 - 2. Motors shall be designed to resist moisture and corrosion, shall be fitted with an epoxy-coated aluminum fan blade, and shall be factory-wired to a NEMA 4X enclosure.
- D. Shroud:
 - 1. The heating elements and motor shall be enclosed within a sturdy, heavy-gauge, stainless steel shroud.
 - 2. The shroud shall be provided with a louver outlet grille and a rear grille, each painted with one coat of zinc chromate primer and 2 coats of corrosion-resistant epoxy painting.
- E. Electrical:
 - 1. Provide a NEMA 4X enclosure to house element terminals and the following standard built-in controls:
 - a. Over-temperature cutout with automatic reset.
 - b. Fan delay relay.
 - c. Required contactors.
 - d. Terminal blocks for field wiring.
 - 2. Provide a separate motor contactor along with a 120 V control transformer.
- F. Provide a universal mounting bracket constructed of 14-gauge stainless steel, and suitable for wall mounting.
- G. The following option controls shall be built-in and factory-rewired in the NEMA 4X enclosure:
 - 1. Selector switch shall be an AUTO/FAN switch.
 - 2. Pilot light to indicate when heating elements are energized.
 - 3. Secondary manual reset thermal cutout.
 - 4. Anodized aluminum or epoxy-painted steel case material.
 - 5. Power disconnect switch.

- H. Accessory Thermostat:
 - 1. Provide an accessory thermostat with each heater for remote wall mounting.
 - 2. The thermostat shall be UL-listed and provided with a NEMA 4X enclosure.
 - 3. The thermostat shall have the following features:
 - a. Switch-activated temperature offset function to shift the cut-in and cutout setpoints by an adjustable offset based on the status of an external switch.
 - b. Lockable front panel touchpad which allows set up and adjustment of setpoint, differential, with a concealed jumper which locks the touchpad to deter unauthorized adjustment of the control settings.
 - c. Acceptable manufacturers:
 - 1) Johnson Controls A419 Series.
 - 2) Approved Equal.

2.05 EXPLOSION RESISTANT ELECTRIC UNIT HEATERS

- A. General:
 - 1. UL listed for Class 1, Group D, Division 1 areas.
- B. Construction:
 - 1. Fan and heater case: Non-sparking aluminum.
 - 2. Heating bank: Cast aluminum.
 - 3. Junction box: Cast aluminum.
 - 4. Epoxy/Polyester powder paint.
- C. Fan:
 - 1. Explosion proof, thermally protected, permanently lubricated ball-bearing motor.
- D. Accessories:
 - 1. Wall mounting bracket.
 - 2. Explosion proof wall thermostat (40-80F).
 - 3. Explosion proof disconnect.

2.06 OPERATING REQUIREMENTS

- A. Refer to Equipment Schedules in the Drawings for performance and operating requirements.

PART 3 EXECUTION

3.01 GENERAL

- A. Install unit heaters as indicated in the Drawings and in accordance with the manufacturer's recommendations and recommended clearances from combustibles.

3.02 TRAINING

- A. The manufacturer shall provide a minimum of one 1/2-hour training session, as specified in Section 01660. Coordinate training sessions with Project Representative. Conduct one training session per week on consecutive weeks to accommodate the shift schedules of operation and maintenance staff.
- B. Coordinate training for all HVAC systems to eliminate redundancies between HVAC units.

END OF SECTION

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SECTION 15633

NATURAL GAS UNIT SPACE HEATERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies gas unit heaters for indoor space heating applications.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ANSI Z 83.8/CSA 2.6	American National Standard/CSA Standard for Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces
NFPA 54	National Fuel Code for Gas Comments and Installation
NFPA 70	National Electrical Code (NEC)
UL 795	Standard for Commercial-Industrial Gas
SMC	Seattle Mechanical Code
SFGC	Seattle Fuel Gas Code

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's catalog or other data confirming conformance to specified design, material and equipment requirements.
- C. Electrical and control diagrams.
- D. Operation and maintenance information: Section 01730.
- E. Layout and mounting detail drawings and engineering calculations indicating design moments, shears, and other forces sealed by the Specialty Structural Engineer submit concurrent with shop drawings.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment No.	Description	Type
UH854377	Panel Room Unit Heater	Fan Type Gas Unit Heater
UH854375	C2 Room Unit Heater	Fan Type Gas Unit Heater
UH854976	Shop Room Unit Heater	Fan Type Gas Unit Heater
UH854574	Pump Room Unit Heater 1	Blower Type Gas Unit Heater
UH854575	Pump Room Unit Heater 2	Blower Type Gas Unit Heater
UH854978	Generator Room Unit Heater	Fan Type Gas Unit Heater

2.02 GENERAL

- A. Unit heaters shall bear the label of a rating agency recognized in the State of Washington and shall conform to NEC requirements.

2.03 ACCEPTABLE MANUFACTURERS

- A. Modine.
- B. Sterling.
- C. Hastings.
- D. Reznor.
- E. Approved Equal.

2.04 STANDARD UNIT HEATERS

- A. General: Standard unit heater shall be for installation in non-hazardous and non-corrosive environments.

2.05 MATERIALS

- A. Gas fired unit heaters: Provide completely factory assembled, piped, wired and test fired.
- B. Type: Separated combustion with power exhaust.
- C. AGA Certified and conform with latest ANSI Standards for safe and efficient performance.
- D. Provide with 2 point suspension hangers.
- E. Casing:
 - 1. Casings die formed, minimum 20 GA galvanized steel and finished in baked enamel.
 - 2. Bottom panel removable to provide service access to burners, pilot and orifices.
 - 3. Pilot accessible through side panel access plate.
- F. Heat exchanger:
 - 1. 316 stainless steel heat exchanger.
 - 2. Non-prorated warranty free from defective material and workmanship for period of 10 years from date of Substantial Completion.
- G. Draft diverter: Constructed of corrosion resistant aluminized steel.
- H. Burners:
 - 1. Die formed, corrosion resistant aluminized steel, with stainless steel port protectors.
 - 2. Individually removable.
 - 3. Individually adjustable, manually rotated air shutter adjustment.
- I. Fans:
 - 1. Fan blades constructed of aluminum with an aerodynamic contour.
 - 2. Dynamically balanced.
 - 3. Rubber-in-shear isolators between fan/motor combination and unit heater casing.

- J. Motors: 115V/60 Hz/1P, totally enclosed with built-in thermal overload protection.
- K. Controls:
 - 1. Factory installed junction box provided for power connections.
 - 2. 24 volt combination single stage automatic gas valve.
 - 3. Main operating valve and pilot safety shutoff.
 - a. Pressure regulator.
 - b. Manual main and pilot shutoff valve.
 - c. Adjustable pilot valve.
 - d. Suitable for maximum inlet pressure of 0.5 psi (14 IN WC) natural gas.
 - 4. 24 volt control transformer.
 - 5. High limit.
 - 6. Fan time delay relay.
 - 7. Thermostat.
 - 8. Wiring diagram.
 - 9. Controls factory installed (except thermostat) in unit to cycle fan to maintain space setpoint temperature.
- L. Intermittent pilot ignition:
 - 1. Solid state ignition control system ignites pilot by spark during each cycle of operation.
 - 2. When pilot flame is proven, main burner valve opens to allow gas flow to burners.
 - a. Pilot and burners are extinguished during off cycle.
- M. Accessories:
 - 1. Vertical combustion air/vent kit including concentric adapter (UH854377 and UH854375)
 - 2. Horizontal combustion air/vent kit including concentric adapter (UH854976, UH854574, and UH854575 and UH854978).
 - 3. Disconnect.
 - 4. Manual shut off valves.
 - 5. Mounting bracket.
 - 6. Downturn nozzle kits (UH854377, UH854375, UH854974, and UH854976).
 - 7. Two stage natural gas valve.
 - 8. Flexible piping connection.

2.06 OPERATING REQUIREMENTS

- A. Refer to Equipment Schedules in the Drawings for performance and operating requirements.

PART 3 EXECUTION

3.01 GENERAL

- A. Install unit heaters as indicated in the Drawings and in accordance with the manufacturer's recommendations and recommended clearances from combustibles.
- B. Responsible for design approval and installation of seismic bracing and anchorage system. Design and install seismic anchorage and bracing for all floor or ceiling mounted equipment as required per SMACNA and all applicable state and local code.

3.02 TRAINING

- A. The manufacturer shall provide a minimum of one 2-hour training session, as specified in Section 01660. Coordinate training sessions with Project Representative. Conduct one training session per week on consecutive weeks to accommodate the shift schedules of operation and maintenance staff.

B. Coordinate training for all HVAC systems to eliminate redundancies between HVAC units.

END OF SECTION

SECTION 15700

DUCTLESS CEILING CASSETTE SPLIT SYSTEM HEAT PUMP UNITS

PART 1 GENERAL

1.01 DESCRIPTION

- A. This Section specifies ceiling cassette split system heat pump unit including ceiling mounted indoor unit, floor mounted outdoor remote condenser unit and accessories for cooling/heating system of the electrical room.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This section incorporates by reference the latest revision of the following documents. These references are part of this Section as specified and modified. In case of a conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
AMCA	Certified Ratings Program
ARI 410	Forced-Circulation Air-Cooling and Air-Heating coils
ARI 430	Central-Station Air Handling units
NFPA 70	National Electrical Code(NEC)
NFPA 90A	Installation of Air Conditioning and Ventilation System
UL 465	Central Cooling and Air Conditioners

- B. Compatibility: The Heat Pump units shall comply with ARI 430, ARI 410 and shall bear ARI label. The unit shall meet the UL 465 standards, and all wiring shall be in accordance with the NEC.
- C. The heat pump unit shall be stored, handled, and delivered per the manufacturer's recommendation. Any damage to the unit shall be replaced with a new unit; repair is not acceptable.

1.03 SUBMITTALS

- A. Submittals shall be provided in accordance with section 01300 and shall include the following:
1. Indoor unit and condenser unit technical data including cooling and heating capacities and performance information for the specified operating conditions.
 2. Installation drawings showing details of vibration isolation system, general dimensions, piping and electrical connections. Provide construction details, weight of the equipment, and installation support drawings.
 3. Indoor unit and condenser unit's wiring diagrams for control system and electric power system.
 4. Manufacturer's specification data and descriptive literature, including materials list.
 5. A copy of this specification section and all referenced sections with each paragraph check marked to show specification compliance or marked to show deviations.
 6. Operation and maintenance information: Section 01730.
 7. Certification that the units have been tested and rated in accordance with the applicable AMCA standard test code and certified ratings program.
 8. NEC and UL labels.
 9. Noise test data as specified in Section 11030.
 10. Forms: 11000-A, 11000-B and 11060-A; Section 01999.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Number	Equipment Type	Description
ME854274	Indoor Unit	Ceiling mounted indoor horizontal
HP854274	Condenser Unit	Remote air cooled condenser unit

2.02 ACCEPTABLE MANUFACTURERS

- A. The ceiling cassette unit shall be Mitsubishi series indoor unit and condenser unit, or Approved Equal modified as necessary to provide the specified features and to meet the specified operating requirements.

2.03 OPERATING REQUIRMENTS

- A. Indoor Unit: Indoor unit shall be a compact ceiling mounted evaporator section with wired control system. Refer to equipment schedules in the drawings for performance.
- B. Remote Condenser: Condensing units shall match with the indoor unit evaporator direct expansion cooling coil load requirements, as specified in this Section. Refer to equipment schedules in the drawings for performance.

2.04 MATERIALS

Component	Material
Structural base	Steel channel
Fan housing	Galvanized 16 gage steel
Fan wheel	Galvanized steel
Shaft	Solid steel
Coil casing	Galvanized 16 gage steel
Coil fins	Aluminum
Coil	Nickel and chromium
Drain pan	Stainless steel

2.05 EQUIPMENT FEATURES

- A. Indoor Unit:
 1. General: The indoor unit shall be factory assembled, wired and run tested. The unit shall contain all factory wiring, piping, control circuit boards and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dry air instead of R22 before shipping from the factory.
 2. Unit Cabinet: The casing shall be fabricated with 18 gage galvanized steel and shall have white finish. The unit casing shall be fabricated for multi directional drain and refrigerant piping and electrical connections.
 3. Fan: The evaporator fan shall be inline type with direct drive multi speed motor. The fan shall be statically and dynamically balanced with permanently lubricated bearings. The fan discharge shall be provided with adjustable guide vanes to change air flow direction from side to side. The fan discharge shall be provided with motorized damper to change direction of airflow from up and down.
 4. Filter: The indoor unit shall be equipped with MERV 10 filter.

5. Cooling Coil: The evaporator coil shall be constructed with nonferrous material with smooth plate fins and copper tubing with silver alloy brazed joints connection. The tubing shall have inner grooves for high efficiency heat exchange. The coil shall be pressure tested at the factory. The cooling coil shall be provided with a stainless steel condensate drain pan with minimum 1" drain pipe connection.
6. Electrical: The indoor unit electric power shall be 208 volts, 1 phase, 60 hertz. The electric motor shall meet the requirements of the Section 11060.
7. Control: The ceiling cassette heat pump unit shall have a complete factory wired control system to perform operation of the system. The control system shall consist of two microprocessors one in the indoor ceiling mounted unit and second in the wall mounted remote controller interconnected with single non-polar two wire cable with no splice. The wall mounted controller shall consist of On/Off switch, cool/dry fan selector, thermostat setting, timer mode, high/low fan speed, auto vane selector, test run switch and check mode switch. The thermostat shall have 2°F temperature increments with a range of 65 to 85°F. The microprocessor located in the indoor unit shall have the capability of sensing return air temperature and indoor coil temperature, receiving and processing commands from the wired wall mounted controller, providing emergency operation, and controlling the condenser unit operation. The control system shall be capable of automatic restart of the heat pump unit when power is restored after interruption. The control system electric power voltage shall be 12 volts DC and provided by the indoor unit. The microprocessor within the wall mounted remote controller shall provide automatic cooling, display set point and room temperature, and check mode for memory of most recent problems. The wall mounted controller shall control the indoor unit air sweep louvers, and shall provide On/Off switch.

B. Condenser Unit:

1. General: The Condenser unit shall be completely factory assembled, piped, wired and tested. The condenser unit shall be designed specifically for use with the indoor unit. The unit shall be equipped with a circuit board that interface with the indoor unit and perform all functions necessary for operation. Provide unit with seacoast protection.
2. Unit Cabinet: The casing shall be fabricated with 18 gage galvanized steel, and coated with a powder coated baked enamel.
3. Fan: The condenser unit shall be upward air flow and shall be furnished with either one or two direct drive propeller type fans. The fan shall be provided with raised guard to prevent contact with moving parts. The fan motor shall be mounted for quiet operation.
4. Coil: The condenser coil shall be nonferrous construction with corrugated plate fins and copper piping. The coil shall be protected with integral metal guard. The refrigerant flow from the condenser shall be controlled by means of a metering orifice.
5. Compressor: The compressors shall be high performance rotary type. Crankcase heater shall be factory mounted on the outside of the compressors. The condenser unit shall be equipped with accumulator, internal thermal overload, and high pressure safety switch. The compressors shall be mounted to avoid vibration. The condenser unit shall be able to operate at 0°F ambient temperature without additional low ambient controls. The condenser unit shall be able to operate with a maximum height difference of 164 feet and have refrigerant tubing length of 164 feet between indoor and condenser unit without the need for line size changes, traps or additional oil.
6. Electrical: The condenser unit's electric power shall be 208 volts, 1 phase, 60 hertz. The electric motor shall meet the requirements of the Section 11060. The condenser unit shall operate and controlled by the microprocessor located in the indoor unit. All control wiring interconnections between indoor and condenser units shall be with single non-polar cable with no splice.

2.06 CONTROL STRATEGY

- A. The ceiling cassette heat pump unit will operate automatically as required to maintain the room temperature at set point. The room temperature shall be set at 75F (adjustable) in summer and 60F (adjustable) in winter. When the room temperature is less than 75F but higher than 60F, the complete unit including indoor and condenser units shall be off. The unit shall turn on when room temperature is 75F or higher or 60F or lower.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Ceiling cassette heat pump unit shall be installed as specified and shown on the drawings in accordance with manufacturer's recommendations. The heat pump unit including indoor unit installation, condenser unit installation, wall mounted remote controller, refrigerant piping, refrigerant charging, electric power, control wiring, and start-up shall be conducted by the manufacturer's certified installer. Refrigeration piping shall be connected to the indoor unit and condenser unit coils through flexible connections. The unit shall comply with noise requirements as specified in this section and requirements of Section 11030. The installation shall be certified on Form 11000-A specified in Section 01999.
- B. Condensate drain piping from indoor unit pan shall be extended to the nearest equipment drain as shown in the drawings.

3.02 FIELD QUALITY CONTROL

- A. After completion of installation, the heat pump unit shall be completely field-tested and balanced in accordance with the Section 15990 to guarantee compliance with these specifications. Following installation, the Contractor shall demonstrate to the Project Representative that the equipment operates in accordance with the control strategy described in this Section.

3.03 TRAINING

- A. The manufacturer shall provide a minimum of one 2-hour training session, as specified in Section 01660. Coordinate training sessions with Project Representative. Conduct one training session per week on consecutive weeks to accommodate the shift schedules of operation and maintenance staff.
- B. Coordinate training for all HVAC systems to eliminate redundancies between HVAC units.

END OF SECTION

SECTION 15820

CEILING FANS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies ceiling-mounted circulation fan complete with mounting hardware and wall control.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
UL507	Standard for Safety for Electric Fans
UL 1004-1	Standard for Safety for Rotating Electrical Machines - Part 1 General Requirements.
UL 1004-3	Standard for Safety for Thermally Protected Motors.
UL 1004-7	Standard for Safety for Electronically Protected Motors

- B. Sustainability Certification:
 - 1. Forest Stewardship Council (FSC) certification.
 - 2. ENERGY STAR[®] certification – ENERGY STAR Most Efficient 2015.
- C. Qualifications:
 - 1. The fan and any accessories shall be supplied by manufacturer that has a minimum of ten (10) years of product experience.
 - 2. ISO 9001- certified.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Forms: 11000-A and 11060-A: Section 01999.
- C. Product technical data.
- D. Operating and maintenance information: Section 01730.
- E. Spare Parts: Section 01750.
- F. Shop drawings: drawings detailing product dimensions, weight, and attachment methods.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product in original, undamaged packaging with identification labels intact. The fan shall be new, free from defects, and factory tested.
- B. The fan and its components shall be stored in a safe, dry location until installation.

1.05 WARRANTY

- A. The manufacturer shall replace any products or components defective in material or workmanship, free of charge to the customer, pursuant to the complete terms and conditions of the Non-Prorated Warranty in accordance to the following schedule:
1. Industrial and Commercial Installations:

Item	Period of Coverage
Motor	2 years
All other components	1 year

PART 2 PRODUCT

2.01 ACCEPTABLE MANUFACTURER

- A. Big Ass Solutions.
- B. Approved Equal.

2.02 CEILING FAN

- A. Complete Unit:
1. Regulatory Requirements: The fan assembly, as a system, shall be ETL-certified and built pursuant to relevant safety standards as described above.
 2. Sustainability Characteristics: The fan shall possess the ENERGY STAR Most Efficient 2015 designation. The fan assembly, as a system, shall be built pursuant to environmental and sustainability standards of the Forest Stewardship Council.
 3. Quality: The fan shall display good workmanship in all aspects of its construction. Field balancing of the airfoils shall not be necessary.
 4. Colors: Airfoil colors shall be selected by project representative.
- B. Mounting System:
1. Low Profile Mount:
 - a. The low profile mount shall be suitable for flat ceilings as low as 8 ft tall.
 - b. The fan shall be equipped with a mounting plate, rubber bumpers, mounting brackets, a compact, low-profile motor hub assembly, and mounting hardware.
 - c. The fan shall be available with a diameter of 52 IN or 60 IN.
 2. Standard Mount:
 - a. The standard mount shall be suitable for flat ceilings with heights ranging from 8.5–12 ft.
 - b. The fan shall be equipped with a rubber bushing, mounting bracket, wiring cover, wiring cover trim, standard motor hub assembly, and mounting hardware.
 - c. The fan shall be available with a diameter of 52 IN or 60 IN.
 3. Universal Mount:
 - a. The universal mount shall be suitable for flat or sloped ceilings with heights ranging from 8.5–18 ft.
 - b. The fan shall be equipped with a mounting bracket, canopy, mounting ball and wedge, extension tubes, wiring cover, motor hub, and mounting hardware.
 - c. A 7-inch, 20-inch, and 32-inch extension tube shall be included with 52-inch and 60-inch fans. A 20-inch and 32-inch extension tube shall be included with 84-inch fans.
 - d. The fan shall be available with a diameter of 52 IN, 60 IN, or 84 IN.

- C. Airfoils:
1. The fan shall be equipped with three airfoils spanning a total diameter of 84 IN, as specified.
 2. Airfoils shall be made of aluminum.
 3. Airfoils finish shall be coordinated with Project Representative.
 4. Airfoils shall be suitable for indoor spaces only.
- D. Motor:
1. The fan shall have an electronically commutated motor (ECM) rated for 100–240 VAC, single-phase.
 2. The motor shall draw 1.41–52 watts depending on the speed at which the fan is operated and if a light is installed.
 3. The fan shall be designed for continuous operation in ambient temperatures of 32–104°F and humidity range of 20–90% (non-condensing).
 4. The fan's motor unit and motor unit trim and finish shall be as specified by the project representative.
- E. Safety Cable:
1. The fan shall be equipped with a safety cable that provides an additional means of securing the fan assembly to the building structure. The safety cable shall be 1.5 mm in diameter and fabricated of aircraft steel.
 2. Field construction of safety cables is not permitted.
- F. SenseME™ Technology:
1. The fan shall be equipped with SenseME Technology for smart automation, and shall be able to wirelessly connect to local Ethernet networks or host a network. The fan's Wi-Fi capability shall permit over-the-air firmware updates.
 2. SenseME Technology control features shall be managed by users via the Home app. The Home app shall be supported by Android™ and iOS® mobile digital devices.
 3. Home App Control Modes:
 - a. Smart Mode: Alternates between seasonal settings—Smarter Heating and Smarter Cooling—to maintain comfort and maximize energy savings.
 - b. Smarter Cooling: The user sets their ideal temperature, and the fan automatically adjusts to find the most comfortable fan speed.
 - c. Smarter Heating: Automatically recirculates heat by increasing in speed when the user exits the room. When the user reenters the room, the fan slows.
 - d. Smart Thermostat: Automatically signals the fan to switch from Smarter Cooling to Smarter Heating when a connected smart thermostat switches to Cooling or Heating Mode.
 4. Scheduling: Sets precise schedules for fan control modes.
 5. Whoosh® Mode: Silently varies fan speed to mimic cooling natural breezes.
 6. Sleep Mode: Responds to changing conditions to provide customized comfort all night long.
 7. Rooms: Enables users to group multiple fans in the same space for synchronized operation. Users shall be able to use the Home app or the Wall Control to automate fan and light functions or adjust settings manually.
 8. Manual Speed Control: Speed settings range from 0 (Off) to 7 (High).
 9. Home Account: Allows for integrated controls between fans and smart thermostats located on the same Wi-Fi network.
- G. Sensors:
1. Motion sensor: The fan and light turn off or on to the last enabled speed or brightness when a person leaves or enters the room.
 2. Temperature and humidity sensor: The fan monitors room temperature and humidity in order to automatically adjust fan speed to reach the user's optimum thermal comfort level.

- H. Display and sound:
 - 1. Changes to fan settings shall be confirmed with auditory feedback (a beep) and/or visual indication of the active setting.
 - 2. The fan mode indicators shall be located on the bottom of the fan and shall be visible from the floor. Indicators shall automatically turn off approximately five seconds after a setting is activated.
 - 3. Users shall have the ability to turn off the indicators and auditory feedback.

- I. Remote Control:
 - 1. The fan shall be equipped with a compact IR remote control that allows intuitive operation of the fan in the following modes:
 - a. Speeds 0 (Off) through 7 (High).
 - b. Sleep Mode: Pressing the Sleep button on the remote shall activate the user's Home app Sleep settings or Wake Up settings.
 - c. Timer Mode: In Timer Mode, the fan runs at a set speed until the programmed time period ends.
 - d. Whoosh Mode: Silently varies fan speed to mimic cooling natural breezes.
 - 2. Each operating mode shall be indicated by a pattern on the fan mode indicators, which shall be located on the bottom of the fan and shall be visible from the floor. All indicators shall automatically turn off approximately five seconds after the last control button is pressed.
 - 3. The remote shall be 1.2 IN wide x 3.4 IN tall x 0.2 IN thick and shall operate on a CR 2025 3 V lithium battery (included).

- J. Wall Control:
 - 1. The fan shall be equipped with a wireless Wall Control in addition to the standard remote control, as specified by the project representative.
 - 2. The Wall Control shall include temperature, humidity, and motion sensors.
 - 3. The user shall be able to use the Home app to group the Wall Control with one or more fans for simultaneous control of fan speed and app features.

PART 3 EXECUTION

3.01 PREPARATION

- A. The fan location shall have an appropriate ceiling-mounted outlet box marked, "Acceptable for Fan Support." If there is not an appropriate outlet box already installed at the location, one shall be installed on a ceiling joist or beam and be properly wired. Additional mounting options may be available. Consult the installation guide for additional details.

- B. The fan location shall be free from obstacles such as lights, cables, or other building components.

- C. Check the fan location for proper electrical requirements. Consult the installation guide for appropriate circuit requirements.

3.02 INSTALLATION

- A. Install the fan according to the manufacturer's installation guide, which includes acceptable mounting methods.

- B. Required Distances:
 - 1. For 84-inch fans, the airfoils shall be at least 8 ft. above the floor.
 - 2. The airfoils shall have at least 2 ft. clearance from all obstructions.
 - 3. The fan shall be within a 30 ft. radius of where the mobile digital device will be used for control. (Line-of-sight obstructions may create a smaller maximum range.)

4. The fan shall not be located where it will be subjected to rain or continuous wind gusts, or in close proximity to the outputs of HVAC systems or radiant heaters. Consult the installation guide for additional details.
- C. Install and set up the Home app according to the manufacturer's instructions.

END OF SECTION

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SECTION 15828

CENTRIFUGAL FIBERGLASS REINFORCED PLASTIC (FRP) FANS AND BLOWERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies centrifugal belt-driven fiberglass reinforced plastic (FRP) fans and blowers for corrosive air service, suitable for operation in Class I, Division 2, Group D environment.
- B. All parts of this Section apply to OCU exhaust fans. Where the term fan is used in this specification, it refers to odor control unit (OCU) exhaust fans and blowers.
- C. Requirements for enclosure exhaust fans are specified in 2.06 and only in parts of this Section where explicitly stated.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
AMCA 210	Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating
AMCA 300	Reverberant Room Method for Sound Testing of Fans
AMCA 301	Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 99-0401	Classification for Spark Resistant Construction
ANSI S1.4	Sound-Level Meters
ANSI S1.6	Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurements.
ASME RTP-1	American Society of Mechanical Engineers, Reinforced Thermoset Plastic Corrosion-Resistant Equipment
ASTM C582	Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment
ASTM D4167	Fiber-Reinforced Plastic Fans and Blowers
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
NBS PS 15-69	National Bureau of Voluntary Standards Custom Contact-Molded Reinforced-Polyester Chemical-Resistant Process Equipment

- B. Unit Responsibility:
 - 1. The system shall be the end product of one responsible system manufacturer. The Contractor shall assign unit responsibility to the manufacturer of the fans provided under this section. This manufacturer is the Unit Responsibility manufacturer and has unit responsibility for the equipment assembly specified in this section, the motors specified in Section 11060 and the variable frequency drives specified in Section 16158. Agents, representatives, or other entities who are not a direct component of the manufacturing corporation will not be acceptable as a substitute for the manufacturer's corporation in meeting the requirement for Unit Responsibility.

2. The Unit Responsible manufacturer shall ensure coordination of design and selection of all system components such that all equipment provided as part of the Unit Responsibility is compatible and operates reliably and properly to achieve the performance requirements specified. Unit responsibility for related components in an assembly does not require or obligate the Unit Responsibility manufacturer to warranty the workmanship or quality of component products not manufactured by them.
3. The Contractor shall coordinate equipment selection with the Unit Responsible manufacturer and shall be responsible for providing the equipment as specified herein. Contractor shall assure that all equipment systems provided as part of the system are the products for which Unit Responsibility has been coordinated by the Unit Responsible manufacturer in this Section.
4. The requirement for Unit Responsibility shall in no way relieve the Contractor of responsibility for performance as specified in the Contract Provisions.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Product technical data:
 1. Fan performance curves for the specified operating conditions and for the ultimate capacity conditions.
 - a. The initial submittal shall include generic fan curves from the manufacturer's standard literature.
 - b. The final submittal shall include actual factory test performance curves as outlined in this Section.
 2. Information on the fan motor, pulley and sheaves at the operating rpm.
 3. Bearing ratings with supporting calculations for the fan and motor at design conditions.
 4. Dimensioned drawing of fan including motor, V-belt drive and base.
 5. Vibration isolation design data in accordance with Section 11021.
 6. Fan inlet and outlet flexible connections.
 7. Sound power level ratings in eight octave bands in accordance with AMCA Standards 300 and 301.
 - a. Octave band sound power levels generated by the fan at the specified/scheduled operating point.
 8. Sound pressure level at 5-feet from the fan per the testing requirements of this Section.
 9. Motor sound power and pressure level data.
 10. Acoustical enclosure:
 - a. Shop drawings.
 - b. Performance information.
 - c. Equipment and instrumentation information.
 - d. Structural/electrical design detail.
- C. Operations and maintenance information: Section 01730.
- D. Certification that the units have been tested and rated in accordance with the applicable AMCA Standard Test Code and Certified Ratings Program for both air and sound performance:
 1. Factory test report:
 - a. Fans listed in this Section shall be fully tested, as a complete unit, at the factory.
 - b. Factory fan curves shall be submitted as part of the testing certification.
- E. Certification by fan manufacturer that the submitted variable frequency drive (VFD) for the fan is compatible with the supplied fan and motor. See Section 16158.
- F. Spare Parts: Section 01750.
- G. Forms: 11000-A and 11060-A (Section 01999).

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment No.	Equipment Name	Type
EF854715	OCU Exhaust Fan 1	Pad mounted centrifugal
EF854725	OCU Exhaust Fan 2	Pad mounted centrifugal
MTR854715	OCU Exhaust Fan 1 Motor	Explosion Proof
MTR854725	OCU Exhaust Fan 2 Motor	Explosion Proof
EF854716	Enclosure Exhaust Fan 1	
EF854726	Enclosure Exhaust Fan 2	

2.02 ACCEPTABLE MANUFACTURERS

- A. OCU Exhaust Fans:
 - 1. Aerovent.
 - 2. Hartzell.
 - 3. Approved Equal.

- B. Acoustical Enclosure:
 - 1. dB Noise Reduction.
 - 2. Aeroacoustic Corp.
 - 3. VAW Systems.
 - 4. Approved Equal.

2.03 PERFORMANCE REQUIREMENTS

- A. General:
 - 1. Fans shall be designed and selected for continuous outdoor operation with air containing corrosive and flammable vapors and gases generated from the treatment and conveyance of municipal wastewater.
 - 2. Vapors and gases may be expected to include methane, hydrogen sulfide, chlorine gas, sulfur dioxide, gasoline vapors, ammonia, and water saturated air.
 - 3. The air stream may also be expected to contain droplets of dilute sulfuric acid.
 - 4. Air stream temperatures are expected to vary between 45 degrees F and 95 degrees F.

- B. Operating Requirements:
 - 1. Select the fans to achieve the indicated operating capacity at no greater than 85 percent of maximum recommended rpm.
 - 2. Fans shall be non-overloading at all points on their curve. Capacity shall be determined in accordance with AMCA Standard 210.
 - 3. Provide fans for stable operation at all design points listed (if applicable).
 - a. The fan duty point at design flow and static pressure shall be at least 1 inch W.C. below the unstable region on the fan curve. The unstable region is defined as the area in which the fan curve has more than one possible airflow at a single static pressure.
 - 4. Fans shall be suitable for operation in Class I, Division II, Group D environment.
 - 5. Sound pressure levels at 5 feet from the fan, without the use of any sound attenuating components and assuming a ducted inlet and outlet, shall not exceed 80.0 dBA calculated with a directivity factor (Q) = 2.

Equipment number	Operating Point	Capacity SCFM	Static pressure, inches W.C	Wheel diameter, inches	Fan speed, rpm	Max. motor, HP	Max. motor speed, rpm	Voltage/phase
EF854715	1	13,000	15	27	2,450	50	1,800	480V/3
	2	6,500	--	--	--	--		

Equipment number	Operating Point	Capacity SCFM	Static pressure, inches W.C	Wheel diameter, inches	Fan speed, rpm	Max. motor, HP	Max. motor speed, rpm	Voltage/phase
EF854725	1	7,000	15	24.5	2,747	30	1,800	480V/3
	2	3,500	--	--	--	--		--

C. Sound power levels:

1. Octave band sound power levels, measured in accordance with ANSI S1-21, ASHRAE 36, and AMCA 300, shall not exceed the following values.
2. Octave Band Sound Power Level, dB re: 10⁻¹² Watts.
3. Octave Band Center Frequency, Hertz.
4. EF854715:

Element	63	125	250	500	1000	2000	4000	8000
Inlet	104	102	100	101	95	95	92	90

5. EF854725:

Element	63	125	250	500	1000	2000	4000	8000
Inlet	99	97	96	95	95	92	89	84

2.04 MATERIALS

A. Components:

Component	Material
Housing	Fiberglass reinforced plastic
Wheel	Fiberglass reinforced plastic
Door gasket and shaft seal	Neoprene or Teflon
Hub	Type 316 stainless steel encapsulated in FRP
Bolts	Type 316 stainless steel
Base	Epoxy coated steel
Belt Drive/Motor Cover	Epoxy coated steel
Shaft	Type 316L stainless steel

B. FRP Fabrication:

1. General:
 - a. Wheel and housing shall have a carbon-rich resin (graphite impregnated) coating on air stream contact surfaces and shall be grounded through the fan base to prevent static buildup.
 - b. Construction type and material thicknesses shall be in accordance with ASTM D4167.
 - c. Visual defects of all FRP construction shall meet the requirements of ASTM C582 and RTP-1.
2. Housing:
 - a. Ultraviolet light stabilized.
 - b. All resin shall achieve a Class I flame spread in accordance with ASTM E84.
 - 1) Antimony pentoxide may be used, if necessary, to achieve the required flame spread rating.
 - c. Built up with laminate construction:
 - 1) Vinyl ester resin such as Dow Derakane 510A-40, or Approved Equal.
 - 2) C-glass or equivalent veil for corrosion resistance.
 - 3) Chopped strand fiberglass for structural core strength.
 - d. Inner layer: 100 percent resin gel coat.
 - e. Corrosion barrier: A 10 mil C-glass or equivalent corrosion resistant veil followed by another resin rich gel coat layer and another C-glass or equivalent veil:
 - 1) Minimum thickness: 50-100 mils.
 - f. Structural core layer: Comprised of resin and chopped strand fiberglass. Total glass content shall be a minimum of 30 to 40 percent.

- g. Exterior layers: A 10 mil C-glass surfacing veil with a smooth exterior resin coat free of any exposed glass fibers:
 - 1) The exterior FRP on fans shall include an intumescent gelcoat that meets both a flame spread of 25 or less and a smoke development rating of 50 or less in accordance with ASTM E84.
 - a) Two (2) coats of PPG Speedhide Flat Latex paint No. 42-7 or an Approved Equal product, in accordance with the manufacturer's recommendations.
- h. Provide housing with an access door.
- 3. Wheel:
 - a. Backward inclined fan wheel, built up using laminate construction.
 - b. Resin: vinyl ester such as Dow Derakane 510A-40, or Approved Equal.
 - c. All resin shall achieve a Class I flame spread in accordance with ASTM E84.
 - 1) Antimony pentoxide may be used, if necessary, to achieve the required flame spread rating.
 - d. First layer of wheel laminate: 100 percent resin gel.
 - e. Corrosion barrier: A 10 mil C-glass or equivalent corrosion resistant veil followed by another resin rich gel coat layer and another C-glass or equivalent veil:
 - 1) Minimum thickness: 50-100 mils.
 - f. Structural core layer: Comprised of resin and chopped strand fiberglass. Total glass content shall be a minimum of 30 to 40 percent.
 - g. Rotation (as observed from drive end):
 - 1) EF854715: counterclockwise.
 - 2) EF854725: clockwise.

2.05 CONSTRUCTION

- A. FRP fabrication shall be in accordance NBS PS 15-69.
- B. Fans:
 - 1. V-belt driven, centrifugal design with backward curved blade.
 - 2. Arrangement 9 (motor located on side of bearing pedestal), as indicated in the Drawings.
 - a. Weather/protective cover over fan drive and motor with 1/8 IN thick reinforced loaded vinyl wrap.
 - 1) Cover material: epoxy coated steel.
 - 3. Configurations shall be as indicated in Drawings.
 - 4. Fan wheel: Overhung type with at least 2 bearings located away from the air stream. The stainless steel shaft hub and bushings shall be completely encapsulated in a reinforced plastic laminate:
 - a. Wheel shall be provided with an abrasive/erosion resistant coating suitable for wet, corrosive environments.
 - 5. Provide a sleeve extending from the back plate of the wheel through the fan housing for protection of the fan shaft.
 - 6. Inlet cone shall have a wiper bar for stability at upper portions of the fan curve.
 - 7. Rotor: Statically and dynamically balanced after fabrication.
 - 8. Provide Teflon seals to minimize air leakage.
 - 9. Provide a 1-1/2-inch FRP drain at the lowest point of the scroll housing.
 - 10. Provide flanged inlets and outlets suitable for a flanged flexible connection. Flanges shall be factory drilled.
 - 11. Inlet and outlet flexible connections shall be provided by the fan manufacturer and shall match the fan inlet and outlet.
 - 12. All fasteners shall be stainless steel.
 - 13. Base shall be fabricated of epoxy coated steel, adequately braced, and equipped with lifting eyes.
 - 14. Provide an inspection port cleanout door.
 - 15. Fans shall conform to AMCA 99-0401 Type A or B spark resistant construction.
 - 16. Fans shall have a single grounding connection point that will provide complete grounding for the fan unit (housing, shaft, wheel, bearings and all other components).

- C. Motor:
 1. Motor shall be explosion proof, Class I, Division 1, as specified in Section 11060.
 2. Motor shall be inverter duty and suitable for service with a VFD per Sections 11060 and 16158.
- D. Bearings and Drive Assembly:
 1. Provide the fan with adjustable pitch sheaves and adjustable motor base suitable for a plus or minus 5 percent adjustment in operating speed.
 2. Bearings shall be self-aligning, grease lubricated and prelubed, antifriction bearings of the pillow block type, complete with grease fittings.
 3. All bearings shall have an L-10 rating life of 100,000 hours.

2.06 ACOUSTICAL ENCLOSURE

- A. Double acoustical wall, free-standing frame of structural shapes with stationary and hinged, locking door panels.
 1. Materials: Type 304 stainless steel.
 2. The frame shall be designed for allow complete breakdown for shipment and be removable for servicing of equipment.
 3. Weather tight construction.
 4. Interior panels shall be perforated with a minimum of 2 inches of insulation behind.
 5. Roof sloped a minimum 1/8 inch per foot away from the main entrance door to accommodate drainage.
 6. Door panels shall be located on the side of the enclosure as indicated in the Drawings and allow for access to the fan belt and motor.
 - a. Size: single 6 ft wide double-door assembly.
 7. Provide a fire extinguisher per Section 10520 and mount inside the enclosure doorway.
 8. Transparent plastic windows shall be provided on each side of the structure to allow for inspection of the fan from the exterior.
 - a. Size: 2 ft x 2 ft.
 - b. Locate as directed by the Project Representative to ensure a clear view of the fan belt/motor.
 9. The wall panels shall accommodate penetrations of the ductwork at the locations indicated in the Drawings.
 - a. Penetrations shall be designed to provide vertical support of the duct (guide support) as defined in Section 13234, and allow for thermal expansion of the duct.
 10. Minimum of four stainless steel lifting eyes installed on the shelter to allow for lifting as a unit after construction.
 11. Footprint: provide minimum interior clearances and dimensions as indicated in the Drawings.
 12. Height:
 - a. As needed to accommodate odor control exhaust fans and interior equipment.
 - b. Minimum interior clearance from floor to ceiling: 8 FT.
 13. Enclosure Exhaust Fans:
 - a. EF854716 and EF854726.
 - b. Fans shall remove heat from the enclosure and provide airflow for the drive motor.
 - c. Control Strategy.
 - 1) The fan will be operated through a local HOA switch on the motor starter and via the Pretreatment HVAC Control Panel.
 - a) When the HOA is in Hand the fan will turn on.
 - b) When the HOA is in Auto, the fan will be called to run by the Pretreatment HVAC Panel.
 - d. Minimum flow of 6 air exchanges per hour (ACH) for enclosure interior while operating.
 - e. Fan operational feedback to the control system shall be as indicated in the Drawings.
 - 1) Motor temperature switch (overheating) shall initiate a fan fail signal.
 - f. Mount on the top or side of the enclosure in a baffled noise insulated enclosure.
 - g. Supply duct and louvers shall be provided on the sides of the enclosure opposite the exhaust fan to allow for cooling air to pass through the enclosure and effectively sweep the space.
 - h. Duct and fan materials of construction shall be Type 304 stainless steel or aluminum.

- i. AMCA Class A or B spark-resistant construction.
 - j. Motor:
 - 1) See Section 11060.
 - 2) 120V, 1 PH.
 - 3) Rated for service in the interior of the enclosure.
 - 4) Combination motor starter with overload protection.
 - 5) Temperature switch.
 - 6) Starter enclosed in a NEMA 250 Type 7 enclosure (with HOA control) mounted on the acoustical enclosure and prewired to fan motor.
 - 7) Provide disconnect per NEC.
- B. The interior of the enclosure and all associated equipment shall be rated for a Class I, Division 2, Group D environment.
- C. Noise Reduction:
- 1. Meet the following requirements under all operating conditions for noise generating equipment, accessories, and penetrations associated with the enclosure:
 - a. Sound pressure not to exceed 55 dBA at 5 ft from the exterior wall of the enclosure.
- D. Design Requirements:
- 1. Structural:
 - a. Design in accordance with applicable Sections of the latest edit of the following:
 - 1) AISC Specifications for Structural Steel Buildings.
 - 2) AISI Specifications for the Design of Cold-Formed Steel Structural Members.
 - 3) Metal Building Manufacturer's Association (MBMA) Low Rise Building Systems Manual.
 - 4) AWS D1.6, Structural Welding Code – Stainless Steel.
 - b. Loads:
 - 1) Vertical live load: greater than 25 psf applied to horizontal projection of the roof.
 - 2) Wind, Snow and Seismic Loads: as indicated in the Drawings. See Section 01031.
 - 3) Reduction of loads due to tributary loaded areas shall not be permitted. All distributing of equipment loads imposed on the building system shall be done in accordance with the MBMA Low Rise Building Systems Manual.
 - c. Enclosure design shall be prepared, stamped, dated and signed by a Professional Engineer licensed in the state of Washington.
 - 2. Electrical:
 - a. Provide interior lighting as indicated in the Drawings.
 - b. Provide one exterior 20-amp, 120-volt, PVC toggle switch with a gasketed, spring-loaded, PVC cover for manual control of light fixtures. Wire switch to interior lighting.
 - c. All wiring and conduit shall be in accordance with Division 16 and the Drawings.
 - d. Mount local control and equipment in accordance with Division 16 and the Drawings.
 - 3. Instrumentation:
 - a. See Division 16 and 17 for instrumentation requirements.
 - b. Field adjustable temperature switch, as required by this Section, to measure temperature within the enclosure and provide an alarm to the Pretreatment HVAC Control Panel.
 - c. Fire detection instrumentation as indicated in the Drawings.
 - d. Atmospheric monitoring equipment (LEL, H₂S) shall be integrated with the enclosure as required in the Drawings. Coordinate equipment mounting and penetrations to provide a fully operational system and maintain the integrity of the enclosure.
 - e. All instrument mounting locations shall be approved by the Project Representative.

2.07 SOURCE QUALITY CONTROL

- A. Balance and Vibration: Fans and enclosure exhaust fans specified in this Section shall be balanced at the factory to operate without vibration throughout the full operating range specified.

- B. Factory test fans and enclosure exhaust fans in accordance with the AMCA Standard Test Code and Certified Ratings Program for both air and sound performance:
 - 1. Provide complete factory test performance curves across the full range of operating conditions the fans and enclosure exhaust fans can achieve.
 - 2. Factory test shall confirm the static pressure, speed and BHP of the design operating point.
 - 3. Test data shall include measured BHP, flow, static pressure, fan speed and motor speed across the full range of operating conditions.
 - 4. The Engineer reserves the right to witness the factory testing. Inform the Project Representative and the Engineer at least 30 days prior to the factory tests.

2.08 CERTIFICATION

- A. Fans and enclosure exhaust fans shall bear the AMCA rating seal.

2.09 SPARE PARTS

- A. Procedures: Section 01750.
- B. Provide one extra set of V-belts for each fan and enclosure exhaust fan.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install each fan and enclosure exhaust fan as specified and in accordance with manufacturer's recommendations.
- B. Connect ductwork to fans and enclosure exhaust fans through flexible connections. The flexible connections shall be provided by the fan manufacturer for the fan inlet and outlet flanges.
- C. See Section 15901 for control strategy and Section 17570 for integration with the plant control system.
- D. Vibration isolation mounting Type A: Section 11021.
- E. Bases and seismic restraints: Section 11021.
- F. Anchorage: Section 11050.
- G. Certify the installation as operational on Form 11000-A: Section 01999.

3.02 FIELD QUALITY CONTROL

- A. After completion of installation, field test each fan and balance in accordance with Sections 01660 and 15990, except as modified below:
 - 1. The fan operating point, for the purpose of balancing (Operating Point 1), shall be at a flow that is approximately 10 percent greater than the nominal operating point listed in this Section (to account for grease filter pressure loss) and the balancing points listed on Drawing 700-M503.
 - a. The balancing point shall be selected by the Project Representative based on the factory test report.
 - b. See Section 15901 for Operating Point 1 and Operating Point 2 control requirements.
 - 2. Measure the negative pressure of the Screenings Room, Equalization Basin, and Solids Holding Tank during balancing and for a continuous 24 hour period after the fans have been balanced.
 - a. Provide the negative pressure measurement data as part of the Final Report per Section 15990.

3. Vibration Test:
 - a. Test fans operating under balanced conditions.
 - b. Conducted by factory-trained technician or authorized representative.
 - c. Measure root-mean-square (RMS) velocity at all bearings in the axial (parallel to shaft) and radial (perpendicular to shaft) directions to provide a velocity profile in the X-Y-Z dimension for each bearing.
 - 1) Velocity shall not exceed 0.1 in/s or the manufacturer's recommendation, whichever is lower.
 - d. Field verify the natural frequency of the fan and confirm it is a minimum of 120% of the maximum fan speed.

3.03 TRAINING

- A. Procedures: Section 01660.
- B. One hour of classroom training and three hours of hands-on instruction covering the theory, operation, and basic maintenance procedures for the fan and motor assembly.
- C. Certify the training is complete on Form 11000-B: Section 01999.

END OF SECTION

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SECTION 15835

AIR HANDLING UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies single-zone air handling units for mechanically cooled electrical rooms, screening room, and administrative areas.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
AFBMA	Anti Friction Bearing Manufacturers Association Standards on Load Ratings and Fatigue Life
ARI 430	Air Conditioning and Refrigeration Institute Standards on Central Station Air Handling Units

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Shop Drawings and equipment data: per Section 11000.
- C. Complete cooling coil and control panel information.
- D. Certification that the units have been tested and rated at standard ARI 430 rating conditions in accordance with the applicable ARI Certified Ratings Program.
- E. Certification that the units are UL listed.
- F. Noise data: Section 11030.
- G. Operating and maintenance information: Section 01730.
- H. Spare Parts: Section 01750.
- I. Forms: 11000-A and 11060-A: Section 01999.
- J. Layout and mounting detail drawings and engineering calculations indicating design moments, shears, and other forces sealed by the Specialty Structural Engineer submit concurrent with shop drawings.

1.04 ENVIRONMENTAL CONDITIONS

- A. Ambient temperature:
 - 1. Winter 24 degrees F.
 - 2. Summer 85 degrees F.

- B. Relative humidity: 42%.
- C. Elevation above sea level: 20 ft.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

A. Equipment list:

Equipment No.	Item
AHU854873 / HP854873	Indoor Air Handling Unit / Outdoor Heat Pump
AHU854975 / HP854975	Indoor Air Handling Unit / Outdoor Heat Pump
AHU854973 / HP854973	Indoor Air Handling Unit / Outdoor Heat Pump
AHU854977	Packaged Air Conditioner
AHU854374	Outdoor Make Up Air Handling Unit

B. Performance: see HVAC schedules indicated in the Drawings.

2.02 ACCEPTABLE MANUFACTURERS

- A. Trane.
- B. Carrier.
- C. Hastings.
- D. Approved Equal.

2.03 FABRICATION AND MANUFACTURER (PACKAGED AIR CONDITIONER)

A. General:

1. The units shall be convertible airflow.
2. DX cooling, gas heat.
3. Unit shall be factory assembled, internally wired, fully charged with R-410A.
4. Vibration isolation and seismic restraints: Section 11021.
5. Single point power.
6. The base of unit shall be insulated with 1/8 inch, foil faced, closed cell insulation.
7. Comply with noise requirements and controls as specified in Section 11030.
8. Designed for outdoor service.
9. Factory applied finish.
10. Black Epoxy Pre-coated coils.
11. Complete coat condenser coil.

B. Controls:

1. Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring.
2. 24 volt electromechanical control circuit shall include control transformer and contactor pressure lugs for power wiring.
3. Unit shall have single point power entry as standard.

- C. Casing:
 - 1. Unit casing shall be constructed of zinc coated, galvanized steel.
 - 2. Exterior surfaces shall be phosphatized, and finished with a weather resistant baked enamel finish.
 - 3. Unit's surface shall be tested minimum 672 hours in a salt spray test.

- D. Fan section:
 - 1. Indoor fan shall be direct drive plenum fan design.
 - 2. Statically and dynamically balanced.
 - 3. Outdoor fan shall be direct-drive, statically balanced, draw through.
 - 4. Indoor fan shall have variable speed direct drive motors.
 - 5. Motor shall be thermally protected.
 - 6. Permanently lubricated ball-bearings.
 - 7. AFBMA L-10 bearing life: 200,000 hours.
 - 8. Built in thermal overload protection.

- E. Fan motor and drive unit:
 - 1. TEFC, energy efficient, severe duty, as specified in Section 11060.
 - 2. Voltage requirement as indicated in the equipment schedules.

- F. Compressor:
 - 1. Welded shell.
 - 2. Hermetically, scroll type with centrifugal type oil pumps.
 - 3. Crankcase heater.
 - 4. Internal overloads.
 - 5. Voltage requirement as indicated in the equipment schedules.

- G. Cooling coil section:
 - 1. Internally finned, copper tubes mechanically bonded to a configured aluminum plate fin.
 - 2. Direct expansion.
 - a. Coils shall be leak tested at the factory.
 - b. The assembled unit shall be leak tested to 465 psig.

- H. Filter section:
 - 1. Access doors for filter removal.
 - 2. Filters as specified in Section 15880.

- I. Gas Heating Section:
 - 1. Progressive tubular heat exchanger.
 - 2. Stainless steel burners and corrosion resistant steel.
 - 3. Suitable for use with natural gas.

- J. Refrigerant circuit:
 - 1. Thermal expansion valve.
 - 2. Service pressure ports.
 - 3. Filter driers.
 - 4. Sight Glass.

- K. Accessories:
 - 1. Programmable thermostat.
 - 2. Low ambient cooling.
 - 3. 2" MERV 8 filter.
 - 4. Duct smoke detector.
 - 5. Motorized outside air damper.
 - 6. Variable speed direct drive motor.
 - 7. Disconnect.

8. Economizer.
9. Clogged filter/fan failure switch.
10. Flexible gas piping connection.

2.04 FABRICATION AND MANUFACTURER (SPLIT HEAT PUMP)

A. Outdoor Unit:

1. Casing and frame:
 - a. Material: Heavy gage galvanized steel.
 - b. Installation: Base equipped with lifting brackets with lifting holes.
 - c. Removable end panel for access to components and connections.
 - d. Weather resistant baked enamel finish.
2. Compressors:
 - a. Single zone variable volume, two separate and independent refrigerant circuits, dual compressor, and Reliatel controls (AHU854873/HP854873 & AHU854973/HP854973 only).
 - b. Direct drive hermetic scroll compressor.
 - c. Positive displacement oil pump.
 - d. Crankcase heater.
 - e. Reversing valves.
 - f. Internal temperature and current sensitive motor overloads.
3. Refrigeration circuit:
 - a. Sight glass.
 - b. Filter dryer.
 - c. Manual shut-off valve.
 - d. High pressure relief valve.
 - e. Thermal expansion valves.
4. Condenser coils:
 - a. Nominal 3/8 IN OD seamless copper mechanically bonded to corrugated aluminum fins.
 - b. Factory leak tested at 315 psig under water.
5. Condenser fans:
 - a. Direct drive.
 - b. Propeller type.
6. Condenser fan motors:
 - a. Heavy duty, inherently protected, non-reversing.
 - b. Permanently lubricated bearings.
 - c. Integral rain shield.
 - d. Current and thermal overloads.
7. Expansion valve:
 - a. Designed and sized specifically for heat pump service.
8. Reversing valve:
 - a. Four-way interchange reversing valve, operates on pressure differential between the outdoor unit and indoor unit.

B. Indoor Unit:

1. Materials:
 - a. Casing: Zinc coated, heavy gage steel.
 - b. Framework: Steel angle.
 - c. Pan insulation: Foam-in-place insulation.
 - d. Casing insulation: Completely insulated with glass fiber material.
2. Casing:
 - a. Sectionalized construction.
 - b. Removable access panels.
 - c. Insulated weatherproof casing.
 - d. Horizontal configuration.
3. Evaporated fans:
 - a. Double-width, double-inlet centrifugal type.

- b. Forward curved or airfoil.
- c. Solid steel shafts.
- d. 200,000 hour relubricative ball-bearings.
- 4. Fan motors:
 - a. Relubricative ball-bearings.
 - b. Thermal overload protection.
 - c. Adjustable or fixed motor sheave.
- 5. V-belts and drives sized for 150 percent motor capacity.
- 6. Isolated fan assembly.
- 7. Filter section:
 - a. Filters: 2 IN throwaway filter.
 - b. Access doors for filter removal.
- 8. Evaporator coils: copper tube, aluminum plate fins.
- 9. Evaporator coil circuiting:
 - a. Adjustable thermal expansion valve per circuit with external equalizer.
 - b. Combination row/split face circuiting.
- 10. Drain pan:
 - a. Mastic-coated.
 - b. Threaded drain connections.
- 11. Size, capacity, and additional accessories as indicated in the Drawings.
- 12. Single point power entry.
- 13. Evaporator defrost control.
- 14. Accessories:
 - a. Programmable thermostat.
 - b. Low ambient cooling to 0 degree F.
 - c. Duct smoke detector (AHU854873/HP854873 & AHU854973/HP854973 only).
 - d. Disconnect.
 - e. Vibration Isolators.
 - f. Black epoxy coated condenser coils (AHU854873/HP854873 & AHU854973/HP854973 only).
 - g. Crankcase heater.
 - h. Epoxy phenolic thermoset coating specially designed to resist coastal corrosion (AHU854975 / HP854975).
 - i. Refer to equipment schedule for additional requirements and accessories.

2.05 FABRICATION AND MANUFACTURER (MAKE UP AIR HANDLING UNIT)

- A. Blower section:
 - 1. Wheel shall be statically and dynamically balanced.
 - 2. Forward curved.
 - 3. Double width, double inlet, class 1.
 - 4. Bearing shall be 200,000 hour ball bearing, self aligning.
 - 5. Cabinet shall be 16 gauge aluminized steel.
 - 6. Cabinet interior insulated with 1-2# density foil face insulation.
 - 7. Access panels for easy access.
 - 8. Driven sheave shall be of a fixed pitch diameter.
 - 9. Driver sheave shall be of a variable pitch diameter.
- B. Burner section:
 - 1. Direct gas fired burner with 22:1 turndown ratio.
 - 2. Shall have stainless steel combustion baffles, non-clogging gas ports.
 - 3. Spark ignition and flame safeguard system.
 - 4. 92% overall thermal efficiency.
 - 5. Insulated burner section.

- C. Motor:
 1. Premium Energy Efficient T-frame.
 2. TEFC corrosion duty blower motor.

- D. Gas and Electric Controls:
 1. Main gas hand shut off valve.
 2. Main and pilot gas pressure regulators.
 3. Pilot controls.
 4. Electric safety shut off valve.
 5. Electronic modulating gas valve with discharge air controller.
 6. Electronic flame safeguard system.
 7. High temperature limit switch.
 8. Airflow switch.
 9. Ignition transformer.
 10. Control transformer.
 11. Motor starter.
 12. Remote control station with system switches and indicating lights.
 13. Control Box.
 14. Automatic mild weather burner lockout.

- E. Accessories:
 1. 2 IN 30% efficiency, pleated MERV 8 filter with magnehelic filter gauge.
 2. Clogged filter switch.
 3. HAND-OFF-AUTO switch mounted on main control panel.
 4. High and low gas pressure switch.
 5. Herisite VR-514F base coat applied to blower wheels and housings.
 6. Birdscreen.
 7. Extended grease lines.
 8. NEMA 4X disconnect switch.
 9. Temp selector dial mounted inside the remote panel.
 10. Gas pilot ignition.
 11. Flexible gas piping connection.
 12. Hinged and gasket motor access door.
 13. Blocked intake switch and signal light.
 14. Low outlet temperature shut off.
 15. Pre-purge cycle.
 16. Remote NEMA 4X control station.
 17. Insulated filter and spacer section.
 18. Weatherproof unit.
 19. Outside surface: Primed with zinc chromate finish coat of enamel.

2.06 SPARE PARTS

- A. Procedure: Section 01750.

- B. Provide the following spare parts:
 1. One set of filters.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's requirements.
- B. Design approval and installation of seismic bracing and anchorage system. Design and install seismic anchorage and bracing for all floor or ceiling mounted equipment as required per SMACNA and all applicable state and local code.

3.02 FIELD QUALITY CONTROL

- A. Field test air handling unit and air cooled condensing unit as one system in accordance with Section 01660.

3.03 TRAINING

- A. The manufacturer shall provide a minimum of one 4-hour training sessions, as specified in Section 01660. Coordinate training sessions with Project Representative. Conduct one training session per week on consecutive weeks to accommodate the shift schedules of operation and maintenance staff.
- B. Coordinate training for all HVAC systems to eliminate redundancies between HVAC units.

END OF SECTION

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SECTION 15846

DUCTWORK THERMAL INSULATION

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies external thermal insulation for metal air ductwork system. External insulation shall be suitable for continuous service on the outside of ductwork.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASTM E84	Test Method for Surface Burning Characteristics of Building Materials
NFPA	National Fire Protection Association

- B. Adhesive used to secure insulation to the ductwork shall meet the recommendations of the manufacturer and the requirements of the Sheet Metal and Air Conditioning Contractor's National Association Duct Lines Application Standard.

1.03 SUBMITTALS (NOT USED)

PART 2 PRODUCTS

2.01 PERFORMANCE AND DESIGN REQUIREMENTS

- A. External ductwork insulation shall be designed to comply with the following:

Item	Value
Thickness	Varies
R-Value	Outside air ducts between louver and isolation damper or equipment: R-13 Outside air ducts between isolation damper and equipment: R-7 Concealed supply air ducts: R-6 Supply air ducts located outside the building envelope: R-8 Return air ducts: R-6
Temperature	40 to 250 oF
Density	3/4 pounds per cubic foot
Moisture absorption	0.2 percent by volume
Fire hazard classification	Flame Spread of 25
Smoke Development Rating	50
Thermal conductivity, based on mean temperature of 75 degrees F	0.30 BTU-inches/hour/sq. ft./degrees F

2.02 ACCEPTABLE MANUFACTURERS

- A. Knauf.
- B. Johns Manville.
- C. Owens Corning Fiberglass.
- D. Approved Equal.

2.03 THERMAL INSULATION MATERIALS

- A. Flexible blanket type.
- B. Made of long, extremely fine, flame attenuated glass fibers, bonded with a thermosetting resin.
- C. Facing: Constructed out of reinforced foil kraft.

2.04 ADHESIVE

- A. Adhesive used to secure insulation to the ductwork shall meet the requirements of the Sheet Metal and Air Conditioning Contractor's National Association Duct Lines Application Standard.

PART 3 EXECUTION

3.01 GENERAL

- A. Insulate all heating and air conditioning supply ducts, return ducts, and outside air intake.
- B. Unless otherwise indicated, do not insulate exhaust air ducts.

3.02 INSTALLATION

- A. Apply external insulation in sections with edges tightly butted. Seal all edges with 4-inch-wide tape, with the ends overlapping at least 6 inches.
- B. Secure external insulation to the ductwork by applying vapor barrier adhesive in 6-inch-wide strips on 12-inch center. Where the underside of horizontal ducts exceeds 24 inches in width, additionally secure insulation by mechanical fasteners or speed clips and nail type stick clips fastened with adhesive.
- C. Use one mechanical fastener for every 2 square feet of duct surface.
- D. Seal all duct penetrations with a piece of the same facing material as the duct and install with the same vapor barrier adhesive.
- E. Extend external insulation and vapor barrier through all duct sleeves.

END OF SECTION

SECTION 15859

IN-LINE CENTRIFUGAL FANS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies duct-mounted, in-line fans complete with fans, motors, and accessories required for ventilation systems.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
AMCA Standard 210	Laboratory Methods of Testing Fans for Rating
AMCA Standard 300	Test Code for Sound Rating
AMCA Standard 0401	Classifications of Spark Resistant Construction

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Fan performance curves for the specified operating conditions.
- C. Forms: 11000-A and 11060-A: Section 01999.
- D. Operating and maintenance information:Section 01730.
- E. Spare Parts: Section 01750.
- F. Layout and mounting detail drawings and engineering calculations indicating design moments, shears, and other forces sealed by the Specialty Structural Engineer submit concurrent with shop drawings.

PART 2 PRODUCTS

2.01 EQUIPMENT LIST

Equipment No.	Description
EF854376	Sample Room Exhaust Fan
SF854377	Panel Room Supply Fan
SF854375	C2 Room Supply Fan
SF854474	East Polymer Room Supply Fan
EF854475	West Polymer Room Exhaust Fan
SF854476	Caustic Room Supply Fan
EF854477	Caustic Room Exhaust Fan
EF854976	Shop Room and Mezzanine Equipment Room Exhaust Fan

Equipment No.	Description
EF854974A	Operations Building (Janitor, WC Room, and Shower Room) Exhaust Fan
EF854974B	Operations Building (WC/F and WC/M Room) Exhaust Fan
SF854572	Pump Room Supply Fan
EF854573	Pump Room Exhaust Fan
RF854973	Meeting Room Relief Fan
EF854978	Standby Generator Room Exhaust Fan
RF854975	Control Room Relief Fan

2.02 OPERATING REQUIREMENTS

- A. Fan motors shall be non-overloading on all points of the operating curve. Fans shall be designed for continuous duty service and comply with the requirements listed in the equipment schedule in the Drawings. Refer to the schedule in the Drawings for performance.

2.03 ACCEPTABLE MANUFACTURERS

- A. Carnes.
 B. Greenheck.
 C. Penn.
 D. Loren Cook.
 E. Approved Equal.

2.04 MATERIALS

Component	Material
Fan wheel	Aluminum
Fan wheel shaft	Aluminum
Fan housing	Aluminum
Fasteners	Stainless steel or Aluminum

2.05 EQUIPMENT

- A. Fan:
- The fan housing shall be square or rectangular in design and shall be provided with duct mounting collars at the inlet and outlet for connection to rectangular ductwork.
 - Fan housing shall be designed to provide access to the motor and fan unit through a gasketed access door. The fan inlet shall be provided with a venturi throat that is overlapped by the fan wheel.
 - The fan wheel shall have backward inclined blades as provided standard by the manufacturer for the specified conditions. The wheel shall be statically and dynamically balanced at the factory. The fan wheel shaft, on belt-driven fans, shall be mounted in a heavy duty, permanently sealed, permanently lubricated, ball bearing pillow block. Bearings shall be rated for a minimum AFBMA L-10 bearing life of 100,000 hours.
 - The entire drive assembly, as a unit, shall be removable without removing the fan assembly from the ductwork. Belt-driven fans shall be furnished with adjustable pitch sheaves and adjustable motor bases suitable for a plus or minus 5 percent adjustment in operating speed. The V-belt drive shall be as specified in Section 11000.

- B. Motor: The motor shall be Type 2 or Type 3 as specified in Section 11060. Motors shall be mounted on vibration isolators and shall be sealed from the exhaust air stream. A motor, belt tensioner, and motor cover shall be provided on all belt-driven fans. A unit mounted disconnect switch (NEMA 4) shall be provided on each fan housing. A flexible conduit, connecting the disconnect to the fan motor, shall be provided. The conduit shall be of sufficient length to permit access to the motor and drive assembly without disconnecting the wiring. Exhaust fan EF854376 shall be explosion proof construction and shall be provided with NEMA 7 disconnect switch.
- C. Accessories:
 - 1. Each fan shall be provided with vibration isolators for fan mounting as specified. Fan inlet guards or safety screen shall be provided on fans with non-ducted inlets. Fan outlet guards or safety screen shall be provided on fans with non-ducted outlets.
 - 2. Provide inline fan with flexible duct connector.
 - 3. When specified, fan shall be provided with filter box constructed of the same material as the fan casing. Filters shall be 2-inch disposable. A differential pressure gage for measuring the resistance to air flow through the filter shall be provided.
 - 4. Provide the following fans with gravity backdraft damper: EF854376, EF854475, EF854477, EF854974A, and EF854974B.
 - 5. Provide the following fans with Heresite coating: EF854376, SF854474, and EF854475. The rest of the fans shall be provided with epoxy powder coating.
 - 6. Refer to fan schedule in the Drawings for additional requirements and accessories.

2.06 SOUND AND VIBRATION

- A. Fans specified in this Section shall operate at noise levels below 30 sones, as defined by AMCA Standard 300, and at tip speeds below 8000 FPM.

2.07 CERTIFICATION

- A. Fans shall bear the AMCA rating seal.

2.08 SPARE PARTS

- A. Procedures: Section 01750.
- B. Provide one set of V-belts for each belt-driven fan.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install each fan as specified and in accordance with manufacturer's recommendations. Provide flexible duct connections where the fan connects to ductwork.
- B. Design approval and installation of seismic bracing and anchorage system. Design and install seismic anchorage and bracing for all floor or ceiling mounted equipment as required per SMACNA and all applicable state and local code.

3.02 FIELD QUALITY CONTROL

- A. Conduct a complete field test of each fan in accordance with Section 15990 to guarantee compliance with the Specifications.

3.03 TRAINING

- A. The manufacturer shall provide a minimum of one 4-hour training session, as specified in Section 01660. Coordinate training sessions with Project Representative. Conduct one training session per week on consecutive weeks to accommodate the shift schedules of operation and maintenance staff.
- B. Coordinate training for all HVAC systems to eliminate redundancies between HVAC units.

END OF SECTION

SECTION 15880

VENTILATION AIR FILTERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies air filters and accessories.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASHRAE Standard 52	Methods for Testing Air Cleaning Devices Used in General Ventilation Removing Particulate Matter
UL 900	Safety Test Performance of Air Filter Units

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Shop drawings and equipment data: Section 11000.
- C. UL Class 2 listing for filters.
- D. Spare Parts: Section 01750.

1.04 ENVIRONMENTAL CONDITIONS

- A. Ambient temperature:
 - 1. Winter: 20 degrees F.
 - 2. Summer: 90 degrees F.
- B. Relative humidity: 10% minimum to 100% maximum.
- C. Elevation above sea level: 13 ft.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Air filters:
 - 1. Farr Company.
 - 2. Airguard Industries, Inc.
 - 3. American Air Filter.
 - 4. Approved Equal.

- B. Air filter gages:
 - 1. Dwyer Instruments, Inc., Model 40.
 - 2. Branom Instrument Company.
 - 3. Approved Equal.

2.02 MATERIALS

- A. Filters:
 - 1. Filter media: reinforced non-woven cotton fabric.
 - 2. Enclosing frame: high wet strength beverage board.
 - 3. Media support grid: aluminum or stainless steel.
- B. Holding frames:
 - 1. 16-gage stainless steel, or aluminum.
 - 2. Stainless steel holding frames in RTP enclosures or at RTP ducts.
- C. Enclosures: Same material as connecting ducts.

2.03 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Filter type: 2-inch, medium efficiency, pleated throwaway type.
- B. Sizes and capacities: as indicated in the Drawings and as required for makeup air unit and air handling unit.
- C. Filter efficiency per ASHRAE Standard 52: 25-35 percent.
- D. Average arrestance per ASHRAE Standard 52: not less than 90 percent.
- E. Initial resistance: not to exceed a 0.28-inch water column at an air approach velocity of 500 feet per minute.
- F. Air filter gages in locations shown on HVAC schematics.

2.04 FABRICATION AND MANUFACTURE

- A. Filters:
 - 1. Effective filter media for 2-inch thick filter: Not less and 4.5 square feet media per 1 square foot of filter face area, containing not less than 15 pleats per linear foot.
 - 2. Media support: Open area not less than 96%, bonded to media.
 - 3. Filter pack bonded to enclosing frame.
 - 4. UL Class 2 listing.
 - 5. Assemble large filters from multiple standard filter units.
- B. Holding frames:
 - 1. Individual holding frames may be riveted or bolted together to form a frame of the desired size.
 - 2. Pressure clamp each filter to a holding frame with removable fasteners so that the filter can be removed and replaced without disturbing adjoining filters and frames.
 - 3. Attach a knife edge seal or sealing gasket to the holding frame for airtight operation.
 - 4. Provide airtight frame to duct connection.

- C. Enclosures:
 - 1. Side access cabinet assembly with gasketed access door and filter holding frame.
 - 2. Positive sealing to prevent filter bypass.
 - 3. Flanged, gasketed connections to ducts.
 - 4. Factory fabricated and assembled.

- D. Air filter gages:
 - 1. One-piece molded plastic construction.
 - 2. Manometer type with zero adjustment.
 - 3. Epoxy coated aluminum scale.
 - 4. Inclined indicating tube.
 - 5. Built-in spirit level.
 - 6. Red and green signal flags to indicate dirty and clean filter.
 - 7. Complete with plastic tubing, fluid and rapid shut-off connectors.
 - 8. Ranges:
 - a. 0.20-2.40-inch W.C. for gages located at wet well exhaust fans.
 - b. 0.10-1.00-inch W.C. for filter gages at all other locations indicated on HVAC schematics.

2.05 SPARE PARTS

- A. Procedures: Section 01750.

- B. Three complete filter replacements for all filters.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

- A. Field-test filters and gages in conjunction with the testing of their respective air handling units and fans.

END OF SECTION

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SECTION 15887

IN-LINE SPIRAL SILENCERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies in-line spiral silencers. The silencers shall be factory assembled and tested. The silencers shall comply with the specified performance requirements and space requirement as indicated in the Drawings and in this Section.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of a conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ASTM E477	ASTM Test Standard for Silencer Rating
ASTM A240	Standard Specification for Chromium and Chromium-Nickel stainless Steel Plate, Sheet and Strap for Pressure Vessels
AMS-4016	Aluminum Alloy, Sheet and Plate 25 Mg – 0.25 Cr (5052-H32) Stain Hardened, Quarter Hardened and Stabilized

- B. Nameplates: Provide the manufacturer's name, address, type or style, model or serial number of the silencer on a stainless steel plate secured to the silencer frame.
- C. Manufacturers Qualifications: Firm regularly engaged in the manufacturing of spiral silencer units and acoustical equipment of type and sizes specified in this Section, and whose products have been in satisfactory use in similar service for not less than five years.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. The following submittals shall be provided:
1. Submit manufacturer's technical product data including material of construction, dimensions, weights, access, performance data, fire classification and installation instructions.
 2. Provide acoustical performance data and confirm testing procedures meet requirements of ASTM E477 testing standard for silencer.
 3. Provide aerodynamic performance and pressure loss of silencers for air flow as shown in this Section.
 4. Provide each silencer unit assembly shop drawing, identify number of sections to be field assembled and installed as indicated in the Drawings.
- C. Provide field test report for each silencer, and conform that the noise and static pressure drop performance of the installed silencers meet this Specifications requirements.
- D. Qualifications.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment	Equipment No.
Engine Generator Inlet Noise Attenuator	NA854902
Engine Generator Outlet Noise Attenuator	NA854903

2.02 PERFORMANCE REQUIREMENTS

- A. General: Each spiral silencer unit shall incorporate numbers of spiral modules as required to fit in the specified space as indicated in the Drawings. Each spiral module shall have four blades 180 degrees spiral noise attenuator consisting of an absorbing layer, a barrier and a second absorbing layer. The noise attenuator blades shall be reinforced and held in place by a matrix of spiral rods. Maximum static pressure loss of silencers shall not exceed 0.08 inches of water column. Testing measurement procedures of the silencers shall conform with ASTM E477 established performance.
- B. Dynamic Insertion Loss: All in-line spiral silencers shall provide the minimum Dynamic Insertion Loss listed below as measured in accordance with ASTM-E477 requirements:

Minimum Dynamic Insertion Loss, dB											
Equipment Number	CFM	Overall Outside Dimension in Inch WxHxL	No. of Modules row-column	Octave Bandcenter Frequency (Hz)							
				63	125	250	500	1k	2k	4k	8k
NA854902	25,000	96x80x24	5-6	18	26	31	37	45	58	43	42
NA854903	25,000	96x80x24	5-6	18	26	32	36	37	45	55	57

- C. Airflow-Generated Noise: All in-line spiral silencers shall not exceed the maximum Airflow-Generated Noise Listed below as measured in accordance with ASTM-E477:

Maximum Airflow-Generated Noise, dB											
Equipment Number	CFM	Overall Face Area SQ-IN	Max Press Loss IN-WC	Octave Band Center Frequency (Hz)							
				63	125	250	500	1k	2k	4k	8k
NA854902	25,000	7,680	0.08	(56)	(44)	(36)	(33)	(29)	(26)	(20)	(18)
NA854903	25,000	7,680	0.08	(53)	(40)	(30)	(22)	(18)	(19)	(24)	(18)

2.03 ACCEPTABLE PRODUCTS

- A. The silencers shall be factory assembled and tested.
- B. The silencers shall comply with the specified performance requirements and space requirement as indicated in the Drawings and in this Section.
- C. The spiral silencers shall be product of a manufacturer whose products have been in satisfactory use in similar service for not less than five years. The spiral silencers shall be fabricated and modified as necessary to provide the specified features and sizes as indicated in the Drawings and specified in this Section.

2.04 MATERIALS

- A. Large size silencer units shall be delivered in sections as recommended by the manufacturer and assembled in the field. The silencer unit sections shall be factory assembled and delivered to site for field assembly of the complete unit as indicated in the Drawings. The silencers sections are factory assembled from group of spiral silencer modules. The spiral silencer modules are 16"x16"x24"size, and the total number of silencer modules for each silencer unit shall be as specified in this Section and as indicated in the Drawings. The modules shall be mechanically bonded to each other in the factory per manufacturer standard to provide structural strength and to maintain the noise attenuation performance as specified in this Section. Each section shall be wrapped around with a minimum gage 14 carbon steel sheet metal to support structural integrity of the section. The complete silencer unit shall be field assembled per the manufacturer's standard production. The exposed part of the silencer units to weather shall be wrapped around with a 1/4 inch thick stainless steel sheet metal as indicated in the Drawings. All modules and sections assemblies shall be welded construction, stiffened to form a solid assembly. All voids around the seams and joints shall be mastic sealed to insure airtight construction.
- B. Inside face of the exterior wrap housing shall be treated with 1.5 pound per square foot layer of acoustical dampening compound and then covered with attenuation materials, as described in the this Section. The inner spiral silencer modules housing shall be constructed with minimum 16 gauge aluminum sheet type 5052-H32 per AMS-4016 all welded construction and shall be treated with 1.5 pound per square foot layer of acoustical dampening compound. The module spiral component reinforcement matrix shall be constructed by stainless steel per ASTM-A240 spiral matrix bonded with attenuation materials, as specified in this Section.
- C. Attenuation material shall be constructed from fiberglass based acoustical insulation bonded to 26 gauge (0.016" thick) acoustical lead sheet as a septum and wrapped with fiberglass scrim cloth. The attenuation material shall be formed to match the housing inner face and spiral matrix shape. The attenuation materials shall be bonded to the housing by mechanical fasteners. The attenuation filling media shall be 70 pounds per cubic feet of fiberglass with a flame-spread maximum of 25, and with minimum 5% compression to eliminate voids due to vibration and settling. The filling media shall be bacterial and fungus resistant, resilient such that it will not crumble or break, and conforming to irregular surfaces. The filling media shall be inert, vermin and moisture proof. The filling media shall not cause or accelerate corrosion of the metal parts of the silencer. All exposed fiberglass face of the attenuation materials shall be bonded with fiberglass scrim cloth treated for minimum 80 psi strength.

2.05 FABRICATION

- A. General:
 - 1. Spiral silencer sections and silencer unit assemblies shall be mechanically joined per manufacturer's recommendation to form a stiffened, solid assembly.
 - 2. All voids around the seams and joints shall be mastic sealed to insure airtight construction.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install silencers in accordance with silencer manufacturer's written instructions and with recognized industry practices to insure that silencers comply with requirements and service intended purposes. The overall silencers shall be assembled in the field as indicated in the Mechanical and Structural Drawings.
- B. Locate each silencer unit accurately in position as indicated, in relation to other work and to prevent leakage of air. Fill the voids with felt, rubber, or neoprene gaskets as necessary to minimize noise leakage through the voids.

3.02 FIELD QUALITY CONTROL

- A. Each silencer shall be field tested to guarantee compliance with this Specification requirements. Provide following test result to project representative for review.
 - 1. Provide net noise reduction level of each silencer between inside face and outside face of silencers when diesel generator is running.
 - 2. Provide noise level at exterior face of exhaust louver for each silencer when diesel generator is running at 6:00 am for minimum environment noise impact.
 - 3. Provide noise level at the property line when the diesel generator is running at 6:00 am for minimum environment noise impact.

END OF SECTION

SECTION 15889

MIST AND GREASE ELIMINATOR FILTERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies duct-mounted dual element filters for removing grease and mist from foul air streams.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of a listed document, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
SMACNA	Rectangular and Round Industrial Duct Construction Standards

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Provide the following information.
1. Manufacturer's catalog and/or other data confirming conformance to specified design, material and equipment requirements.
 2. Mist and grease eliminator filter shop drawings, including dimensions, layout, elements of construction and support design.
 3. Predicted performance data and/or curves as applicable developed for the specific application, confirming conformance to specified design and operating requirements and characteristics.
 4. Weight of heaviest filter pad (dry and wet) to be removed for cleaning.
- C. Operation and maintenance information: Section 01730.
- D. Spare Parts: Section 01750.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment No.	Equipment Name	Type
ME854713	OCU 1 Mist and Grease Eliminator Filter 1 (Screenings Building)	Mist and Grease Combination Filter
PDI854713	OCU 1 Mist and Grease Eliminator Filter 1 Differential Pressure Gauge	Pressure/Differential
ME854723	OCU 2 Mist and Grease Eliminator Filter 1 (Equalization Basin)	Mist and Grease Combination Filter
PDI854723	OCU 2 Mist and Grease Eliminator Filter 1 Differential Pressure Gauge	Pressure/Differential
ME854726	OCU 2 Mist and Grease Eliminator Filter 2 (Solids Holding Tank)	Mist and Grease Combination Filter

Equipment No.	Equipment Name	Type
PDI854726	OCU 2 Mist and Grease Eliminator Filter 2 Differential Pressure Gauge	Pressure/Differential

2.02 PERFORMANCE REQUIREMENTS

A. General:

- Units specified in this Section shall be designed and selected for continuous operation with air containing corrosive and flammable vapors and gases generated from the treatment and conveyance of municipal wastewater.
- Vapors and gases may be expected to include methane, hydrogen sulfide, chlorine gas, sulfur dioxide, gasoline vapors, ammonia, airborne grease, and water saturated air. The air stream may also be expected to contain droplets of dilute sulfuric acid.
- Structurally capable of maximum flows of at least 1.5 times the rated capacity.
- Air stream temperatures are expected to vary between 50 and 95 degrees F.
- Pressure and Vacuum: operating range of 30 inches w.c. positive pressure through 30 inches w.c. vacuum.
- FRP resin, glass reinforcement, corrosion barrier, UV gel coat, and visual acceptance criteria shall meet all the standards of exterior FRP ductwork as outlined in Section 13234.

B. Operating Requirements: The mist and grease eliminators shall comply with the following:

Equipment Number	Capacity, cfm	Operating Pressure drop ¹ , in-w.c.	Maximum Face Velocity fpm	Filter Size (total area)	Droplet Removal
ME854713	13,000	1.25	500	72 inch x 72 inch	99% >10 micron; 80% > 5 micron
ME854723	5,000	1.25	500	42 inch x 42 inch	99% >10 micron; 80% > 5 micron
ME854726	2,000	1.25	500	42 inch x 42 inch	99% >10 micron; 80% > 5 micron

Note 1: Pressure drop measured across the entire filter assembly, from inlet flange to outlet flange.

2.03 ACCEPTABLE MANUFACTURERS

- Spunstrand.
- ECS Environmental Solutions.
- Approved Equal.

2.04 EQUIPMENT FEATURES

- The grease filter and mist eliminator shall consist of two-stage filter pads housed inside a fiberglass reinforced plastic (FRP) enclosure.
 - The first pad shall be a woven polypropylene pad 2 inches thick for grease removal.
 - The second pad shall be woven polypropylene pad 4 inches thick for mist removal.
 - Each pad shall have a uniform exterior frame that fully encompasses and encloses all sides of the pad.
 - Each pad shall be separately removable (the first and second pads shall not be combined in a single frame) for cleaning.

5. Each pad shall be divided into at least two evenly sized sections to minimize the weight of each section for removal.
 - a. Each section shall be separately removable.
 - b. Each section shall have a vertical dimension matching the full height of the filter and a maximum dry weight of 40 lbs.
- B. The housing shall have a hinged access door, with handle, to allow removal and replacement of the filter pads from the accessible side of the unit, as indicated in the Drawings:
 1. Housing door shall be held in place with toggle clamps.
 - a. Acceptable Manufacturers:
 - 1) Kakuta HH-300-S.
 - 2) McMaster-Carr.
 - 3) Approved Equal.
- C. The housing shall be transitioned and flanged for installation in the foul air FRP ductwork.
- D. The flanges shall be drilled and gaskets shall be provided.
- E. A drain connection with a plastic ball valve shall be provided as indicated in the Drawings.
 1. See Section 15050 for piping and Section 15064 for ball valve requirements.
- F. A differential pressure gage shall be provided to measure the pressure drop across unit.
 1. See Division 17 for instrumentation piping and differential pressure gauge requirements.

2.05 MATERIALS

- A. Materials shall be as follows:

Component	Material
Housing	FRP
Filter Support and Sliding Tracks	AISI 304 stainless steel
Grease Pads	AISI 304 stainless steel
Demister Pads	Polypropylene
Gaskets	Neoprene
Fasteners and Anchor Bolts	AISI 304 stainless steel

- B. Housing shall be constructed of FRP meeting the same lining, coating, and design requirements as the internal FRP ductwork specified in Section 13234.
- C. All internal components shall be structurally rated to meet the same pressure rating requirements as those listed for internal FRP ductwork in Section 13234.

2.06 SOURCE QUALITY CONTROL

- A. Factory test (flow/pressure) mist and grease eliminator filters under the following conditions:
 1. Complete unit with all filters installed.
 2. Flow: 1.5 times the rated capacity listed in this Section.
 3. Pressure: Minimum 4 inches w.c. negative pressure at filter inlet.
 4. Medium: Clean air.
 5. Results: Record pressure loss and confirm no leakage at access doors or gauge ports.
 6. Duration: 2 hours.
- B. The Engineer reserves the right to witness the factory testing. Inform the Project Representative and the Engineer at least 30 days prior to the factory tests.

2.07 SPARE PARTS

- A. Procedures: Section 01750.
- B. Four extra filter pads of each size and type (grease filter and mist eliminator) shall be provided.
- C. Two extra sets of gaskets required for the access door.
- D. Spare components shall be tagged and stored in accordance with Section 01740.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install each grease filter and mist eliminator as indicated in the Drawings and as recommended by the manufacturer.
- B. Provide adequate support for the unit such that there is no strain on the ductwork to which it is connected.
 - 1. Supports shall meet the requirements of Section 13234 and be constructed of 316 SST or vinyl ester FRP matching the material requirements of the mist and grease eliminator.
 - 2. Design of supports, including structural calculations, prepared, stamped, dated and signed by a Professional Engineer registered in the state of Washington.
- C. Provide P-trap for drain and route the drain pipe to a point of disposal as indicated in the Drawings.
- D. Temporarily mark (colored tap) the differential pressure gage during commissioning:
 - 1. Mark the low point as the initial clean filter pressure.
 - 2. Mark the high point at 1 inch w.c. above the clean filter pressure.

END OF SECTION

SECTION 15891

SHEET METAL DUCTWORK

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies HVAC systems plenums, sheet metal housings, ductwork, equipment connections, reinforcing and other devices required to make the air distribution systems complete and operational. The FRP foul air ductwork material is specified in Section 13234.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ASHRAE	Handbook - Equipment Volume, Duct Construction
ASHRAE	Handbook - Fundamentals Volume, Duct Design
ASTM A525	General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A527/A527M	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM B209	Aluminum and Aluminum Alloy Sheet and Plate
ASTM B211	Aluminum and Aluminum Alloy Bar, Rod, and Wire
ASTM B308	Aluminum - Alloy 6061-T6 Standard Structural Shapes, Rolled or Extruded
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
SMACNA	HVAC Duct Construction Standards Metal and Flexible
SBC	Seattle Building Code
SMC	Seattle Mechanical Code
UL 181	Factory-made Air Ducts and Connectors

- B. Ductwork construction, installation, and air system performance shall comply with SMC, ASHRAE CH-1 and CH-33, and SMACNA Duct Construction Standards.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Provide the following submittals:
1. An 8-1/2-inch by 11-inch manual with detail sheets or catalog data of flexible duct connectors, duct sleeves, duct access doors, turning vanes, volume dampers, supports, hangers, etc.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide all ductwork, plenums, and all auxiliary work and products of any kind necessary to make the ventilation systems complete and ready for operation. Ductwork shall comply with the following restrictions and conditions:
1. Snap lock seams shall be fully sealed and fastened with screws every 18 inches.

2. Where space conditions permit, full radius turns shall be used at offsets.
3. Turning vanes shall be provided where tees, bends, and elbows are not 1-1/2 times the width at centerline and in all rectangular elbows.
4. Ductwork elbows, take-offs, and fittings shall be in accordance with the SMACNA and ASHRAE standards for the medium pressure air duct.
5. Visible duct deflection, loss of shape, or unwarranted noise or vibration resulting from faulty or inadequate support, reinforcing, metal gauge, fabrication, or joint spacing shall be corrected at no expense to King County.

2.02 DESIGN CRITERIA AND CONSIDERATIONS

- A. General: Unless otherwise indicated, sheet metal gage, reinforcing, hanger and support systems, ductwork joint types and other basic design construction details shall be in accordance with the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) HVAC Duct Construction Standards. Ductwork shall be fabricated to meet the configurations and dimensions indicated in the Drawings. Dimensions specified indicate net free area; dimensions shall be increased by the thickness of the lining where internal lining is required.
- B. Low Pressure Ductwork: Low pressure ductwork shall convey air with a velocity less than 2000 fpm and maximum static pressure of 2 inches of water column. Low-pressure ductwork shall conform to 2-inch w.c. pressure class.
- C. Medium Pressure Ductwork: Medium pressure ductwork, where specified, shall convey air with a velocity greater than 2000 fpm and a maximum static pressure of 6 inches of water column. Medium pressure ductwork shall conform to 6-inch w.c. pressure class.
- D. System Leakage: All joints shall be sealed as required to limit total system leakage to a maximum of 1 percent of the specified equipment air flows.
- E. Change in Duct Size: Change in duct size shall be made by a uniformly tapering section. The change in direction of the tapering section shall not be more than 1 inch in 5 inches of run, unless otherwise specified.
- F. Bends in Duct: With the exception of mitered bends, all bends in ducts shall have inside radii equal to the duct width or diameter. Double wall turning vanes shall be provided at all 90-degree mitered bends.
- G. Duct Sleeves: Whenever ducts extend through concrete or masonry walls, floors or ceilings, they shall be provided with a sleeve as specified in this Section.
- H. Duct Openings: Access doors or hand holes shall be provided in ducts at locations to reach modulating dampers, fusible links, controllers and any other moveable devices in the ducts. The opening shall be 1 inch less duct size or of adequate size to reach in and maintain these devices.
- I. Vibration Isolation Flexible Connections: Flexible connections shall be provided at duct connections to motor-driven air handling equipment and other locations specified. Flexible connections shall be UL approved and provided with the necessary angle, straps, bolts, clips, or other fasteners to secure the flexible material to the equipment and ducts. Flexible connections exposed to the weather shall be provided with approved sheet metal weather covers.
- J. Insulation:
 1. U.L. Labeled, 1.5-pound density, 2-inch thick duct wrap insulation with FSK vapor barrier shall be provided on all concealed supply air and return air ductwork.
 2. U.L. Labeled, 3-pound density, 2-inch thick duct wrap insulation with 8-ounce treated canvas vapor barrier and fire retardant covering shall be provided on all inside exposed supply air and return air ductwork.

3. U.L. Labeled, 3-pound density, 2-inch thick fiberglass board internal insulation with approved weatherproof barrier shall be provided internally on all supply and return air exterior ductwork.
4. Unless otherwise indicated, exhaust air, untempered ventilation air, and foul air ducts need not be insulated.

2.03 MATERIALS

A. Provide the ductwork materials: as indicated in the Drawings and meeting the following requirements:

Component	Material
Duct	Aluminum, alloy 3003-H14, conforming to ASTM B209 and ASTM B211 or Galvanized steel, ASTM A525 and ASTM A527 (Area 900 only) or Stainless steel 316
Duct sleeve	Aluminum, alloy 3003-H14, conforming to ASTM B209 and ASTM B211 or Galvanized steel, or Stainless steel 316, 10 gage to match duct material
Access doors	Aluminum, alloy 3003-H14, conforming to ASTM B209 and ASTM B211 or Galvanized steel, or Stainless steel 316, minimum 10 gage to match duct material
Flexible duct connector	Noncombustible, weather and ozone resistant, abrasion-proof woven fiberglass fabric with coating weighing not less than 24 ounces per square yard. Maximum flame spread rating of 25, smoke rating of 50 for all materials including connecting tape, etc. UL 181 approved.
Turning vanes	Aluminum or galvanized steel or stainless steel 316 to match duct material.
Hangers and supports, rivets, and bolts reinforcing	Aluminum alloy 6061-T6 conforming to ASTM B308 or galvanized steel to match duct material.

- B. Unless otherwise indicated, all HVAC systems supply and exhaust air ductwork material for supply air shall be aluminum.
- C. Diesel generator intake and exhaust cooling air ductwork shall meet the requirements as indicated in the Drawings.

2.04 JOINTS AND REINFORCING

- A. Transverse stiffeners and joints shall be appropriately spaced to maintain duct cross-section integrity in accordance with the pressure class specified and at the prevailing operating velocities.
- B. After joints are crimped, they shall be further secured by bottom punching or riveting.
- C. Longitudinal seams shall be Pittsburgh lock and shall be cross-broken outward. Intake, or exhaust, side ducts shall be cross-broken inward. Discharge ducts shall be cross-broken outward. All plenums and casings shall be similarly cross-broken and further reinforced with 1-inch x 1-inch x 1/8-inch angles running diagonally between joints, riveted to the casings.
- D. Low pressure ductwork shall have slip joints.
- E. Medium pressure ductwork shall have flanged or welded joints.
- F. Joints shall not interfere with airflow in the ducts.
- G. Exterior ducts shall be stiffened, braced, and supported in a manner designed to maintain duct integrity and cross-section under wind and snow loads specified in the appropriate codes or standards.

- H. Interior ducts shall be suitably braced and stiffened at floor and roof penetrations as well as over their unsupported length in a manner designed to maintain duct integrity and limit vibration and noise in accordance with recognized standards of the industry.
- I. Ducts over 17 inches in largest dimension shall be cross-broken or beaded on all four sides. In ducts over 72 inches, 3/8-inch stay rods shall be installed at each transverse joint. Spacing between rods or rods on side of duct shall not exceed 48 inches.

2.05 DUCT SLEEVES

- A. Sleeve flanges shall not be less than 4 inches wide and shall be installed tight against each side of the barrier.
- B. Sleeves shall be 2 inches larger than the duct or external duct insulation.
- C. The space between the duct (or insulation) and the sleeve shall be packed with fiberglass or material of original wall.
- D. Duct flanges not less than 4 inches wide (reword yellow) shall be installed tight against the wall on each side and fastened to the duct sleeves.

2.06 HANGERS AND SUPPORTS

- A. Duct support spacing shall be in accordance with the SMACNA standards for the pressure class and conditions specified and prevailing in the system.
- B. Supports shall be spaced to prevent visible duct deflection and loss of system integrity.
- C. Aluminum ductwork shall be constructed with strength and dimensional stability comparable to conventional steel duct. In the absence of other criteria, aluminum sheet and reinforcing shall have a moment of inertia three times greater than that recommended for steel ductwork.
- D. Supports shall be designed in accordance with the Seattle Building Code.

2.07 ACCESS DOORS

- A. Access doors shall be rigid and shall be provided with airtight gaskets and shall not vibrate or cause noise under service.
- B. Doors shall be continuous hinged type with ventlock latch on outside.

2.08 FLEXIBLE CONNECTIONS

- A. Flexible connection joints shall be airtight and have a minimum allowance of 1-inch slack all around.
- B. Flexible connections shall be designed to be removed from the line and be reinstalled without disassembling adjacent ductwork.
- C. Connections shall be installed with a minimum 4-inch clearance between metal parts on fan connections, equipment connections, and for distribution devices.

2.09 TURNING VANES

- A. Turning vanes shall be 2-inch blades for ducts up to 18 inches in either dimension and shall be 4 1/2-inch blades for larger ducts.

- B. All turning vane assemblies shall be finished with an air-dried phenolic corrosion resistant coating prior to installation.
- C. All turning vanes shall be constructed of double thickness vanes.

2.10 DAMPERS

- A. Balancing dampers shall be provided on medium pressure systems where specified.
 - 1. Single-blade dampers shall be constructed for ducts 9 1/2 inches wide and smaller. Opposed blade dampers shall be constructed with a maximum blade size of 12 inches by 72 inches.
 - 2. Dampers material shall match the ductwork material.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install ductwork in accordance with SMACNA and NFPA. All ductwork indicated in the Drawings is schematic; therefore, changes in duct size, duct configuration, and location may be necessary to conform to field conditions.
- B. Install ductwork and accessories to provide a system free from buckling, warping, breathing, and vibration. Ductwork installation shall permit installation of other required services without piercing, crimping, or reducing duct sizes. Where space conditions permit, use full radius turns at offsets.
- C. Make all ductwork airtight. Seal flanged joints with closed-cell neoprene gaskets compressed between mating flanges. Seal all other joints and seams with liquid or mastic type sealants. Taped joints are not permitted. All joints, both transverse and longitudinal, shall comply with the requirements of SMACNA Seal Class A.
- D. Fabricate all duct fittings with continuously welded seams and joints.
- E. All ductwork shall be fabricated in accordance SMACNA Standards requirements for medium pressure ductwork and shall conform to 6-inch w.c. positive and negative pressure regardless of actual working pressure of the HVAC systems.
- F. Provide volume damper on all branch supply, return, and exhaust ductwork to allow for airflow balance.
- G. Design approval and installation of seismic bracing and anchorage system. Install seismic bracing on HVAC ducts and piping per the latest building code and as required per SMACNA.

3.02 FIELD QUALITY CONTROL

- A. Perform tests as specified in Section 15990.
- B. Provide duct test holes with patches in ducts where directed or necessary for testing and balancing purposes.

END OF SECTION

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SECTION 15892

ACOUSTICAL LINING FOR DUCTS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies acoustical lining for noise reduction in sheet metal ductwork used in heating, ventilating, and air conditioning applications, and lining the generator exhaust plenum.
- B. Duct lining shall be the flexible fiberglass type, generator plenum lining shall be low density polyethylene.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
SMACNA	Duct Liner Application
NFPA 90A	Standard for the Installation of Air-Conditioning and Ventilating Systems

1.03 SUBMITTALS

- A. Procedure: Section 01300.
- B. Acoustic lining material information, thickness and performance data.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Duct Lining:
 - 1. Knauf Fiber Glass.
 - 2. Johnson Manville Corp.
 - 3. Owens Corning Corp.
 - 4. Approved Equal.
- B. Generator Plenum Lining:
 - 1. Armaflex AP Coilflex by Armacell, LLP.
 - 2. K-Flex Duct Liner Gray by K-Flex USA.
 - 3. Approved Equal.

2.02 MATERIALS

Component	Material
Duct Lining	Fiberglass
Adhesive	Waterproof, fire-resistant, NFPA 90A
Mechanical fasteners	Galvanized steel, per SMACNA construction
Plenum Lining	Low Density, Closed Cell, Esoteric Foam

- A. Lining shall be installed in ductwork serving where indicated in the Drawings or specified.

- B. The duct sizes noted indicate net free areas. Duct dimensions shall be increased by the thickness of the lining where lining is specified.

2.03 PLENUM LINING FOAM

- A. Black, low density, closed cell, elastomeric foam with a density of 3-6 pcf, less than 0.50% water absorption (by volume). Flame spread index less than 25, smoke developed index less than 50.
- B. 50 mm thick sound absorption coefficients: 0.23 at 125 Hz, 0.84 at 250 Hz, 0.32 at 500 Hz, 0.60 at 1000 Hz, 0.39 at 2000 Hz, 0.31 at 4000 Hz.

PART 3 EXECUTION

3.01 GENERAL

- A. All portions of duct or plenums indicated in the Drawings to receive duct liner shall be completely covered with liner. All sheet metal plenums shall receive duct liner and be completely covered with liner. Ducts and plenums shall be internally lined with flexible duct liner 1 inch and 2 inches thick, respectively, with 3 pounds per cubic foot density of liner (not including any surface coating or facing). Generator exhaust plenum shall have duct liner and plenum lining as indicated in the Drawings.
- B. Transverse joints shall be neatly butted, and there shall be no interruptions or gaps. The liner surface designed to be exposed shall face the air stream shall be sealed with adhesive. Duct liner shall be adhered to the sheet metal with 100 percent coverage of adhesive, and all exposed leading edges and all transverse joints coated with adhesive. The liner shall be additionally secured with impact applied, hardened steel mechanical fasteners which shall compress the duct liner sufficiently to hold it firmly in place.

END OF SECTION

SECTION 15901

AUTOMATIC HEATING, VENTILATION, AND AIR CONDITIONING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies the HVAC control system and instrumentation.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
AMCA Standard 500	Test Methods for Louvers, Dampers and Shutters
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
Seattle Energy Code	Washington State Energy Code with Seattle Amendments

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's catalog and/or other data confirming conformance to specified design, material and equipment requirements.
- C. Electrical wiring and control diagrams.
- D. Installation requirements, showing clearance required for maintenance purposes.
- E. Operating and maintenance information: Section 01730.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Manufacturer's catalog numbers hereinafter are for reference to type, style, dimension, related items and to establish a standard of quality.
 - a. Reference to a manufacturer's number hereinafter does not imply full compliance to these Specifications.
 - 2. Instrumentation and control systems:
 - a. Honeywell.
 - b. Johnson Control Co.
 - c. Approved Equal.

2.02 EQUIPMENT

A. Electric Control Instruments:

1. Provide stainless steel sensing elements type thermostats with liquid filled, compensated thermal systems so that equally spaced dial graduations are possible over entire range.
 - a. Make thermal systems field detachable with averaging or plain bulbs as installation conditions dictate.
 - b. Provide sensing elements minimum of 60 IN in length and suitable for operation from -30 to 300 DegF.
 - c. Provide reverse acting on-off type thermostats for controlling ventilating fans.
 - d. Provide multiple stage thermostats where designated in Paragraph "Sequence of Operation".
2. Provide transformers for supplying current to control equipment operating at less than 120 V and where required by manufacturer's automatic control system design capable of supplying 125 percent of energy requirements of equipment connected for not less than 1 HR.
 - a. Enclose transformers in UL listed cabinets with conduit connections.
 - b. Provide fused disconnect switches on both primary and secondary sides.
3. Provide low limit electric thermostats of two-position type with 20 FT bulb and manual reset.
 - a. Shall be capable of opening thermostat circuit if any 1 FT section of bulb is subjected to a temperature below thermostat setting.
 - b. Each thermostat shall have two (2) circuits, one (1) to shut down fan, another for alarm.
 - c. Install all freeze-stats to override starter circuits regardless of position.
 - d. For corrosive environments provide thermostats with stainless steel sensing elements.
 - 1) Ensure element is installed to sense coldest point should stratification occur.
4. Provide each thermostat with an accurate red-reading thermometer sensing temperature outside of enclosure.
5. Label thermostat with identification tag of HVAC equipment controlled using phenolic nameplate in accordance with Specification Section 11000.

B. Industrial Controllers:

1. Provide control instruments, devices, and incidentals of industrial process control quality capable of producing the outlined performances.
2. Electronic (and electric) controller shall have three (3) control mode capabilities of proportional rate (time), and dead band within following minimum performance and application criteria:
 - a. Setpoint adjustment: 0 to 110 percent of span.
 - b. Repeatability: Setpoint repeats within +0.1 percent of span.
 - c. Dead band: 1 percent of span, standard.
 - d. Rate: 5 to 30 seconds adjustable.
 - e. Response level: 50 milliseconds for a step change of 1 percent of span beyond setpoints.
 - f. Output: SPDT relay contacts, 5 amps at 117 Vac noninductive.
3. Controller shall be capable of remote setpoint adjustment, permanently mounted in air flow control panel unless otherwise indicated.
4. Provide each controller with instruments (pressure gages, milliampmeters, voltmeters, etc.) to indicate magnitude of output signal in both medium of signal (psig, mA, volt DC, etc.) and percentage of full output signal.

C. Static Pressure Gages:

1. Install gages on control panel for each system.
 - a. One (1) gage shall serve each filter while others shall serve as a check on system.
 - b. Gages shall be Magnahelic by Dwyer 2000 ASF, flush mounted with signal flag for filter gage.
 - c. Install static pressure tips as scheduled under control panel indication points.
 - d. Static pressure ranges:
 - 1) Filter (cartridge): 0 to 2.0 IN WC.
 - 2) Air-handling systems: 0 to 10.0 IN WC (one (1) per air-handling unit).

D. Static Pressure Gages with Alarms:

1. Install Dwyer 3000 photohelic pressure switch/gage with adjustable photocell actuated DPDT relay which can be interlocked for variable dead band control.
 - a. Gage shall be for positive, negative or differential pressure.
 - b. Scale and setpoints shall meet the requirements of the sequence of operation or control panel indication points.

E. Local Temperature Control Panel:

1. Panel shall be floor or wall-mounted and be sized to accommodate electrical switches, protective devices (except electrical switches and devices furnished as an integral part of air handling unit).
2. Mount indicating controllers or receiver-controllers, three-way air valves, relay, EP and PE switches, switching relays, ammeters and other accessory items on local sub-panels set in vicinity of equipment to be served.
 - a. Where two (2) similar items of equipment, such as pumps, are installed adjacent to each other a single panel may be used to contain all instruments.
3. Fully compensated capillaries connected to instruments shall be of sufficient length to allow them to be run between equipment and placed in such a position so that they will not obstruct service of equipment or become damaged.
4. Air pressure gages for pneumatic controls of at least 2 IN DIA shall be provided for indication of transmitter signals and output signal of all controllers, relays, EP switches, outdoor air dampers, PE switches, control valves larger than 4 IN and other points throughout system.
 - a. Provide visual indication for operating purposes.
 - b. Temperature and pressure indicating gages where scheduled for panel door mounting shall be not less than 2-1/2 IN DIA, flush mounted with accuracy of +1 DegF.
 - c. Where a temperature indication gage is used, a pressure gage is not required for same signal.
 - d. Transmitter signal and controller output gages shall be in-line mounted or mounted on controllers if provided with tapped connections.
 - e. One (1) or more permanently mounted gages with flexible hose terminating in a hypodermic needle may be used for checking other parts of control signals; however, signal connections may not be used as a substitute for in-line mounted gages.
 - f. All gages and instruments shall be suitably tagged with their function.
5. Miniature milliamp meters for electronic temperature transmission may be used.
6. Manufacture panels in one (1) of the following manners:
 - a. NEMA electrical panel boxes with windows.
 - b. Install gages flush mounted in swing out panel behind window with instruments and other control items located inside enclosures behind panel.
 - c. Refer to Paragraph "Corrosion Protection."
7. Mount all relays, PE switches, pressure switches, etc., on rear inside of enclosure.
 - a. Tag each instrument corresponding to symbols used on control diagrams.
8. Temperatures, pressures, equipment operation, and related items shall be continuously indicated on panels.
9. Points to be monitored are scheduled in this Section.

2.03 FABRICATION

A. Corrosion Protection:

1. Protect metal parts of controls, instrumentation and related items from corrosive atmosphere by either protective coatings or select materials.
 - a. Aluminum and stainless steel require no further protection.
2. Provide NEMA 4X fiberglass control enclosures with tempered glass windows and vapor tight gaskets, illustrated in Hoffman Bulletin A-50, for protection of controls from corrosive environment.
 - a. Install control instruments inside enclosure and extend remote stainless steel sensing elements through enclosure wall.
 - b. Provide vaportight seals for penetrations of enclosure.

3. Provide in each enclosure industrial corrosion inhibitors, Hoffman Corrosion Inhibitors, as illustrated in Hoffman's technical Bulletin HCI.
4. Protect metal accessory items such as mounting brackets and fasteners not stainless steel, fiberglass or aluminum by epoxy or phenolic coatings.
5. Protect electric motor operator with corrosion inhibitors inside enclosure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with requirements of Section 16120 and Section 16110.
- B. Identification: See Section 11000.
- C. Connect control devices to perform functions indicated and perform in required sequence.
- D. Use remote element temperature transmitters for points of temperature transmitters for points of temperature measurement occurring in air ducts or shafts, or in mechanical piping system.
- E. Use remote element pressure transmitters of panel-mounted pressure gages.
- F. Where continuous indication of space temperature is on local control panels, install a thermostat and a temperature transmitter side by side.
 1. Pipe continuous indication signal to a receiver on panel.
 2. A resistance element or thermocouple signal may be used with continuous indicating meter, calibrated in degrees Fahrenheit.
- G. In general, locate thermostats for room control immediately inside door, above light switch, unless shown otherwise.
 1. Where light switch is in an entryway to room, locate thermostat on wall within room so it is capable of sensing true space conditions.
 2. Prior to installation, coordinate thermostat location with Engineer.
- H. Mount local control panels adjacent to equipment served.
- I. Where a temperature indicating gage is used at the panel, a pressure gage indicating transmitter signal is not required.
- J. Provide appropriate type continuous reading indicator for each controller, transmitter and transducer.
 1. Mount in-line or tapped on controller.
 2. Mount at local control panel.
- K. Gages with flexible hose terminating with hypodermic needle may be used for checking control system.
 1. Do not substitute for in-line gages.
- L. Locate panels so visual observation and adjustment can be accomplished from floor level.

3.02 SEQUENCE OF OPERATION

- A. General:
 1. The sequence of operations provided here is general in nature and does not have all required functions indicated. Refer to the P&IDs and Seattle Energy Code for additional requirements.
 2. Alarms are as specified in Section 17902 and indicated in the Drawings.

3. PLC/DCS I/O and Metrotel I/O points are as specified in Section 17903, Section 17904 and as indicated in the Drawings.
 4. All dampers with position switches shall be proven open prior to starting the associated supply and/or exhaust fans.
- B. Regulator Electrical Room HVAC (200-P007):
1. Regulator Heat Pump Fan Coil (ME854274) and Regulator Heat Pump Outdoor Unit (HP854274) are controlled by controls provided with the units and do not have an interlock with the temperature control system.
- C. Screenings Building HVAC (300-P024):
1. The Screening Room AHU (AHU854374) operates in parallel with the Odor Control Area 1 system to ventilate and freeze protect the Screenings Room.
 2. The airflow will be set as described in the Odor Control Area 1 sequence of operation.
 3. Heating will occur when the room temperature is below the room temperature setpoint. When below the room temperature setpoint the heater gas valve will modulate to maintain discharge temperature setpoint. The discharge temperature setpoint will be reset to maintain room temperature.
- D. Screenings Building C2 Room HVAC (300-P025):
1. The C2 Room HVAC ventilation system will operate as required to maintain the room temperature below the room temperature setpoint.
 2. When the HVAC System is in AUTO the system shall operate as follows:
 - a. When the room temperature is above setpoint the C2 Room Supply Damper and C2 Room Exhaust Damper shall open. When the dampers are proven open the C2 Room Supply Fan (SF854375) shall start and operate at the balanced air flow rate.
 - b. When the room temperature drops below the room setpoint the supply fan shall stop and after a 10 second delay the supply and exhaust dampers shall close.
 3. When the C2 Room HVAC System is in OFF the system supply fan shall stop and the dampers shall close.
 4. The C2 Room Unit Heater operates as a stand-alone system and is not interlocked with the HVAC Control Panel.
- E. Screenings Building Sampling Room HVAC (300-P026):
1. The Sample Room HVAC system provides continuous ventilation and freeze protection to the Sample Room.
 2. The Sample Room exhaust fan runs continuously at the balanced air flow rate.
 - a. If the airflow falls more than 10 percent below the balanced air flow rate the low flow alarm, FSL854376, will activate.
 3. The Sample Room Unit Heater operates as a stand-alone system and is not interlocked with the HVAC Control Panel.
- F. Screenings Building Panel Room HVAC (300-P027):
1. The Panel Room HVAC ventilation system will operate as required to maintain the room temperature below the room temperature setpoint.
 2. When the HVAC System is in AUTO the system shall operate as follows:
 - a. When the room temperature is above setpoint the Panel Room Supply Damper and Panel Room Exhaust Damper shall open. When the dampers are proven open the Panel Room Supply Fan (SF854377) shall start and operate at the balanced air flow rate.
 - b. When the room temperature drops below the room setpoint the supply fan shall stop and after a 10 second delay the supply and exhaust dampers shall close.
 3. When the Panel Room HVAC System is in OFF the system supply fan shall stop and the dampers shall close.
 4. The Panel Room Unit Heater operates as a stand-alone system and is not interlocked with the HVAC Control Panel.

- G. Ballasted Sedimentation Polymer and Coagulant Pump Room HVAC System (400-P009):
 - 1. The Polymer Room HVAC system provides continuous ventilation and freeze protection to the Polymer and Coagulant Pump Room.
 - 2. The East Poly Room Supply Fan and West Poly Room Exhaust Fan run continuously at the balanced air flow rates.
 - a. If the airflow falls more than 10 percent below the balanced air flow rate the low flow alarms will activate.
 - 3. The two Poly Room Unit Heaters operate as a stand-alone system and are not interlocked with the HVAC Control Panel.

- H. Ballasted Sedimentation Caustic Pump Room HVAC (400-P010):
 - 1. The Caustic Room Room HVAC system provides continuous ventilation and freeze protection to the Caustic Pump Room.
 - 2. The Caustic Room Exhaust Fan and Caustic Room Supply Fan run continuously at the balanced air flow rates.
 - a. If the airflow falls more than 10 percent below the balanced air flow rates the low flow alarms will activate.
 - 3. The Caustic Room Unit Heater operates as a stand-alone system and is not interlocked with the HVAC Control Panel.

- I. UV Pump Room HVAC (500-P016, 500-P017):
 - 1. The UV Pump Room HVAC ventilation system will operate as required to maintain the room temperature below the room temperature setpoint.
 - 2. When the room temperature is above setpoint the Pump Room Supply Damper and Pump Room Exhaust Damper shall open. When the dampers are proven open the Pump Room Supply Fan (SF854572) and Pump Room Exhaust Fan (EF574573) shall start and operate at the balanced air flow rates.
 - 3. When the room temperature drops below the room setpoint the supply and exhaust fans shall stop and after a 10 second delay the supply and exhaust dampers shall close.
 - 4. Local HAND-OFF-REMOTE switches will allow the operator to manually start or stop a fan.
 - 5. A timer switch located inside the east entrance will allow the operators to manually start the ventilation system during maintenance if desired.
 - a. The timer shall operate the HVAC system for up to 1-Hour as if the room temperature was above the setpoint and then returns to automatic mode.
 - 6. The two UV Pump Room Unit Heaters operate as a stand-alone system and are not interlocked with the HVAC Control Panel.

- J. Process Electrical Building HVAC (800-P003):
 - 1. The Process Electrical Building HVAC system operates as required to maintain the room temperature setpoints.
 - 2. The Process Electrical Air handling unit runs as required when the temperature is above or below the room setpoints.
 - a. The supply, return, and relief dampers are used for economizer cooling and operate when the outside air temperature is lower than 65 DegF prior to mechanical cooling.
 - b. Mechanical cooling is used when economizer cooling is not sufficient or when the outside air temperature is above 65 DegF.
 - c. The outside and relief dampers are closed during the heating mode.
 - 3. An HVAC system fault will be reported to the Metrotel system if the room temperature is more than 5 DegF higher than the setpoint or the HVAC system fails.

- K. O&M Building HVAC – Meeting Room (900-P007) and Miscellaneous Fans:
 - 1. The Meeting Room HVAC operates on a time clock to maintain the room temperatures setpoints during occupied hours.
 - 2. A temperature sensor in the meeting room shall provide room temperature information to the HVAC control panel.

3. The air handling unit shall maintain the space temperature between the heating or cooling setpoints. A 5 DegF deadband shall prevent the unit from cycling between heating and cooling.
 - a. The air handling unit inlet damper shall be open to the minimum position to provide ventilation air when the building is occupied.
 - 1) When the outside air temperature is below 65 DegF the inlet damper shall open in an economizer cycle to provide cooling prior to starting the heat pump.
 - 2) In the economizer cycle the relief damper shall open and the Meeting Room Relief Fan shall start.
 - b. The heat pump shall provide mechanical cooling or heating as required to maintain the room temperature setpoints.
 4. Operations Building exhaust fans 1 and 2 (EF854974A and EF854974B operate when the building is occupied according to the time clock.
 - a. Fan running feedback shall be provided to the HVAC Control Panel.
- L. O&M Building Control Room and Shop HVAC (900-P008):
1. The Control Room HVAC operates on a time clock to maintain the room temperatures setpoints during occupied hours.
 2. A temperature sensor in the meeting room shall provide room temperature information to the HVAC control panel.
 3. The air handling unit shall maintain the space temperature between the heating or cooling setpoints. A 5 DegF deadband shall prevent the unit from cycling between heating and cooling.
 - a. The air handling unit inlet damper shall be open to the minimum position to provide ventilation air when the building is occupied.
 - 1) When the outside air temperature is below 65 DegF the inlet damper shall open in an economizer cycle to provide cooling prior to starting the heat pump.
 - 2) In the economizer cycle the relief damper shall open and the Meeting Room Relief Fan shall start.
 - b. The heat pump shall provide mechanical cooling or heating as required to maintain the room temperature setpoints.
 4. During occupied hours when the shop temperature sensor is above setpoint, initially 80 DegF adjustable, the shop inlet and exhaust dampers open and the shop exhaust fan starts.
 5. The shop unit heater will start based on a local thermostat and which is not connected to the HVAC control system.
- M. O&M Building Electrical Room HVAC (900-P009):
1. The Electrical Room HVAC system operates as required to maintain the room temperature setpoints.
 2. The Electrical Room Air handling unit runs as required when the temperature is above or below the room setpoints.
 - a. An on-unit economizer and an external relief damper are used for economizer cooling and operate when the outside air temperature is lower than 65 DegF prior to mechanical cooling.
 - b. Mechanical cooling is used when economizer cooling is not sufficient or when the outside air temperature is above 65 DegF.
 - c. The outside and relief dampers are closed during the heating mode.
- N. Generator Room HVAC System (900-P009 and 900-P005):
1. The Generator Room HVAC system will operate as required to maintain the room temperature below the room temperature setpoint.
 2. When the room temperature is above setpoint the Generator Room Exhaust Damper opens. When the dampers are proven open the Generator Room Exhaust Fan shall start and operate at the balanced air flow rates.
 3. When the room temperature drops below the room setpoint the exhaust fan shall stop and after a 10 second delay the supply and exhaust dampers shall close.
 4. Local HAND-OFF-REMOTE switches will allow the operator to manually start or stop a fan.
 5. The generator room unit heater will start based on a local thermostat and which is not connected to the HVAC control system.

6. When the generator is running and the room temperature is below the cooling setpoint the Generator Room Bypass Damper shall open.
- O. Odor Control Area 1, Screenings Building (700-P003, 700-P004):
1. The Area 1 odor control exhaust system pulls foul air from the screenings room and is paced/balanced relative to the Screening Room AHU to create a negative pressure (-0.1 inches water column) in the Screening Room. Interior dampers are balanced for individual input points per the Drawings and Section 15828.
 2. The OCU 1 Exhaust Fan (EF854715) will operate automatically at a pre-set speed on the VFD based on the balanced air flow as indicated in the Drawings and Section 15828 (Operating Point 1).
 3. A secondary operating point will be available to turn the OCU 1 Exhaust Fan down to approximately one-half the balanced flow (Operating Point 2). The Screening Room AHU will also automatically move to a one-half flow setpoint when Operating Point 2 is active.
 4. The Operating Point currently running will be displayed at the Pretreatment HVAC Panel (PNL854374). Operating Point 1 will be the automatic default when the facility is in operation (flow is being sent to the plant from the Georgetown Regulator). Operating Point 2 shall be manually selected by the operators and will only be allowed when the facility is not in operation. Operating Point 2 will be overridden to Operating Point 1 if the facility begins operation while Operating Point 2 is active.
 - a. In the event of an LEL alarm in the screenings building, the Screening Room AHU and OCU 1 Exhaust Fan will continue to run and automatically return to Operating Point 1 regardless of whether the facility is in operation.
 - b. In the event of a fire alarm in the screenings building, the Screening Room AHU and OCU 1 Exhaust Fan will shutdown.
 5. The OCU 1 Exhaust Fan can be manually turned down at the VFD.
 - a. If either the OCU 1 Exhaust Fan or the Screening Room AHU is manually adjusted, an alarm will be initiated to indicate the flow is no longer balanced between the two systems.
 6. OCU 1 Exhaust Fan flow failure is monitored by FSL854715.
 - a. Setpoint: 40 fps.
 - b. If the OCU 1 Exhaust Fan fails, the Screening Room AHU remains on.
 - c. If the Screening Room AHU fails, the OCU 1 Exhaust Fan will shutdown.
 7. Enclosure Exhaust Fan 1 (EF854716):
 - a. A wall/roof mounted fan on the OCU 1 Exhaust Fan enclosure will operate to ventilate the enclosure working space.
 - b. See Section 15828.
 8. The OCU 1 Exhaust Fan enclosure includes temperature, LEL, H₂S and fire detection monitoring.
 - a. See Section 17572 for LEL and H₂S monitoring.
 - b. See Section 16660 for fire detection.
 - c. Enclosure temperature shall be monitored by TSH854715B.
 - 1) Setpoint: 95 °F.
- P. Odor Control Area 2, Equalization Basin and Solids Holding Tank (700-P001, 700-P002):
1. The Area 2 odor control exhaust system pulls foul air from the equalization basin and the solids holding tanks. The supply air to these locations is passive, so there is no supply fan system. Balancing dampers are provided for individual connection points per the Drawings and Section 15828.
 2. The OCU 2 Exhaust Fan (EF854725) will operate automatically at a pre-set speed on the VFD based on the balanced air flow as indicated in the Drawings and Section 15828 (Operating Point 1).
 3. A secondary operating point will be available to turn the OCU 2 Exhaust Fan down to approximately one-half the balanced flow (Operating Point 2).

4. The Operating Point currently running will be displayed at the Pretreatment HVAC Panel (PNL854374). Operating Point 1 will be the automatic default at all times. Operating Point 2 shall be manually selected by the operators and will only be allowed when the facility is not in operation. Operating Point 2 will be overridden to Operating Point 1 if the facility begins operation while Operating Point 2 is active.
5. The OCU 2 Exhaust Fan can be manually turned down at the VFD.
6. OCU 2 Exhaust Fan flow failure is monitored by FSL854725.
 - a. Setpoint: 40 fps.
7. Enclosure Exhaust Fan 2 (EF854726):
 - a. A wall/roof mounted fan on the OCU 2 Exhaust Fan enclosure will operate to ventilate the enclosure working space.
 - b. See Section 15828.
8. The OCU 2 Exhaust Fan enclosure includes temperature, LEL, H₂S and fire detection monitoring.
 - a. See Section 17572 for LEL and H₂S monitoring.
 - b. See Section 16660 for fire detection.
 - c. Enclosure temperature shall be monitored by TSH854725B.
 - 1) Setpoint: 95 °F.

END OF SECTION

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SECTION 15903

DIFFUSERS, GRILLES, AND REGISTERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies diffusers, grilles, registers, and accessories associated with the heating, cooling, and ventilating systems.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
ADC 1 062 GRD-84	Test Code for Grille, Register and Diffuser Performance
ASHRAE	Handbook - HVAC Systems and Equipment Chapter, Air Diffusing Equipment
SMACNA	HVAC Duct Construction Standards Metal and Flexible

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Provide the following submittals:
 - 1. An 8-1/2-inch by 11-inch manual with detail sheets or catalog data for diffusers, grilles, and registers.

1.04 TYPE

- A. All diffusers, grilles, and registers shall be of the size, model, and capacity indicated in the Drawings.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Agitair.
- B. Carnes.
- C. Krueger.
- D. Titus.
- E. Approved Equal.

2.02 MATERIALS

- A. Unless otherwise indicated, the diffusers, grilles, and registers shall be constructed of the same material as the ductwork in which they are installed.

2.03 SUPPLY REGISTERS AND GRILLES

- A. Supply Grille (SG-1):
 - 1. Double Deflection.
 - 2. ¾ inch blade spacing.
 - 3. Steel construction.
 - 4. White finish.

2.04 RETURN/EXHAUST GRILLES

- A. Return Grille (RG-1):
 - 1. Steel construction.
 - 2. ¾ inch spacing.
 - 3. 0 degree deflection.
 - 4. Countersunk screw holes.
- B. Exhaust Grille (EG-1):
 - 1. Aluminum grid, Aluminum border.
 - 2. Free area of at least 90%.
 - 3. Aluminum grid: 1 inch x1 inch x1 inch.
 - 4. White finish.
 - 5. Countersunk screw holes.
 - 6. Mounted in 24x24 panel to lay in 9/16 inch wide x 5/16 inch tall narrow tee ceiling grid.

2.05 DIFFUSERS

- A. Round Diffusers (SD-1):
 - 1. 18 gauge steel.
 - 2. Adjustable, four cones and round neck inlets.
 - 3. Finish shall be white.
 - 4. Airflow discharge pattern shall be field adjustable from horizontal to vertical by extending or retracting the inner three cones.
- B. Square Ceiling Diffusers (SD-2):
 - 1. Modular core.
 - 2. Steel.
 - 3. Finish shall be white.
 - 4. The diffuser core shall consist of fixed louver directional modules, which can be easily repositioned without tools in the field for 1, 2, 3, or 4 way discharge.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Align, connect and install diffusers, grilles, registers and extractors in accordance with the manufacturer's recommendations and with SMACNA.

3.02 FIELD QUALITY CONTROL

- A. Perform testing, adjusting, and balancing per Section 15990.

END OF SECTION

SECTION 15911

DAMPERS AND DAMPER MOTORS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies motorized dampers for control of airflow that are installed in ducts or independently mounted.

1.02 QUALITY ASSURANCE

- A. Reference Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
AMCA Standard 500	Test Methods for Louvers, Dampers and Shutters
SMACNA	HVAC Duct Construction

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Manufacturer's catalog and/or other data confirming conformance to specified design, material and equipment requirements.
- C. Dampers dimensions and installation shop drawings.
- D. Dampers construction information including frame, blade and linkage material data. Type of blades, and air flow and friction loss performance curve.
- E. Damper motors data, full stroke time, electric power, installation support bracket information.
- F. Electrical and control diagrams.
- G. Installation requirements, showing clearance required for maintenance purposes.
- H. Operating and maintenance information: Section 01730.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULE

Equipment No.	Description
DPR854375A	C2 Room Supply Damper
DPR854375B	C2 Room Exhaust Damper
DPR854377A	Panel Room Supply Damper
DPR854377B	Panel Room Exhaust Damper
DPR854572	Pump Room Supply Damper
DPR854573	Pump Room Exhaust Damper
DPR854872A	Process Electrical Supply Damper
DPR854872B	Process Electrical Return Damper

Equipment No.	Description
DPR854874	Process Electrical Relief Damper
DPR854902	Engine Generator Inlet Damper
DPR854903A	Engine Generator Outlet Damper
DPR854903B	Generator Room Bypass Damper
DPR854973A	Meeting Room Inlet Damper
DPR854973B	Meeting Room Return Damper
DPR854973C	Meeting Room Relief Damper
DPR854974A	Operations Building Backdraft Damper 1
DPR854974B	Operations Building Backdraft Damper 2
DPR854975A	Control Room Inlet Damper
DPR854975B	Control Room Return Damper
DPR854975C	Control Room Relief Damper
DPR854976A	Shop Inlet Damper
DPR854976B	Shop Exhaust Damper
DPR854977	O&M Electrical Room Exhaust Damper
DPR854978	Generator Room Exhaust Damper

2.02 ACCEPTABLE MANUFACTURERS

- A. Airolite.
- B. Ruskin.
- C. Construction Specialties.
- D. Approved Equal.

2.03 OPERATING REQUIREMENTS

- A. The dampers shall meet the following requirements. Pressure drop shall not exceed 0.02-inches w.c. at the design air volume.

Equipment No.	Number of Sections	Size of each section, feet		Total CFM
		Width	Height	
DPR854375A	1	40	75	5,500
DPR854375B	1	40	75	5,500
DPR854377A	1	24	24	3,000
DPR854377B	1	40	72	3,000
DPR854572	1	54	96	10,000
DPR854573	1	96	54	10,000
DPR854872A	1	NOTE 1		4,600
DPR854872B	1	NOTE 1		4,600
DPR854874	1	76	36	4,600
DPR854902	4	81	46	25,000
DPR854903A	4	40	40	25,000
DPR854903B	1	18	18	
DPR854973A	1	NOTE 1		3,910
DPR854973B	1	NOTE 1		3,910
DPR854973C	1	NOTE 1		3,810
DPR854975A	1	NOTE 1		1,305
DPR854975B	1	NOTE 1		1,155
DPR854975C	1	NOTE 1		1,155
DPR854976A	1	40	40	1,210
DPR854976B	1	Note 1		1,810
DPR854977	1	96	36	4,800

Equipment No.	Number of Sections	Size of each section, feet		Total CFM
		Width	Height	
DPR854978	1	18	18	1,000

Note 1: Provide dampers to match equipment size.

2.04 EQUIPMENT FEATURES

- A. Heavy Duty Dampers (Generator intake/exhaust):
1. Dampers shall be heavy-duty industrial grade opposed blade control dampers.
 2. Dampers shall be constructed of 14 gage galvanized steel channel frame with 8-inch depth and 2-inch flanges.
 3. Blades shall be V type fabricated from 12 gage galvanized steel. Blades shall be mounted on 0.75-inch type 304 stainless steel axles.
 4. Axles shall be mounted in ball bearings; the bearing shall be externally mounted and shall be replaceable. The axles shall be operated by out of the air stream blade-to-blade stainless steel linkage.
 5. The dampers shall be suitable for pressures to 8.5-inches water column and velocities to 3000 FPM when tested in accordance with AMCA Standard 500.
- B. Control Dampers:
1. Dampers shall be high performance commercial control dampers.
 2. Dampers shall be parallel blade construction for open/closed operation and opposed blade construction for modulating operation.
 3. Damper material shall match the ductwork material, aluminum or galvanized steel.
 - a. Aluminum dampers shall be constructed of 0.125 IN thick aluminum channel frame, 6 IN depth, and have extruded aluminum airfoil type blades.
 - b. Galvanized steel dampers shall have 16 gauge roll-formed galvanized steel channel frames, 6 IN deep, and have 14 gauge roll-formed galvanized steel airfoil type blades.
 4. Dampers shall have neoprene blade edge seals.
 5. Axles shall be hexagonal stainless steel and have replaceable externally mounted bearings.
 6. Leakage shall not exceed 3 CFM/SF at a pressure of 1-inch water column.
 7. The dampers shall be suitable for pressures to 6-inches water column with a blade length of 48 IN and velocities to 3000 FPM when tested in accordance with AMCA Standard 500.
- C. Parallel Blade: Parallel blade dampers shall be constructed such that all damper blades rotate in the same direction when the damper is opened or closed.
- D. Opposed Blade: Opposed blade dampers shall be constructed such that each damper blade rotates in the opposite direction of the blades adjacent to it when the damper is opened or closed.
- E. Operators:
1. Operators shall be provided for each damper section.
 2. Operators shall be 120-volt motor actuators provided complete with all necessary linkage to position the damper throughout its full operating range.
 3. The actuator shall be mounted on the inside of the damper frame.
 4. They shall have sufficient torque to position the damper served at the specified conditions.
 5. Time required for the operator's full stroke shall not exceed 1 minute.
 6. Operator sequence shall be spring powered normally open/electrically driven closed.
 7. Each operator shall be provided with a manual override.
 8. Operators shall include open and closed position switches.

2.05 BACKDRAFT AND BAROMETRIC DAMPERS

- A. Damper frame and blades shall be heavy duty constructed with 6063T5 extruded aluminum, unless otherwise specified. The damper frame shall be minimum 3 inch deep and blades shall be provided with extruded vinyl edge seals to ensure tight closure at working temperature of -50 F to +250 F. Backdraft dampers shall be counterbalanced when installed in vertical position. The blade interconnecting linkage shall be located within the damper frame and out of the airstream. Inline backdraft dampers in the ductwork shall be provided with an open/close position indicator arm to monitor the damper position.

2.06 DAMPER MOTORS

- A. Electric Damper Motor: Damper motors for automatically controlled dampers, where specified or indicated in the Drawings, shall be 120-volt motor actuators provided complete with all necessary linkage and support to position the damper throughout its full operating range. The damper operators shall be industrial heavy duty construction with stainless steel linkage rods, attachments and fasteners. The actuators shall have sufficient torque for the size of damper and positioned properly to serve at the specified conditions. The damper area served by each damper motor shall be minimum as indicated in the Drawing and shall not exceed the maximum area recommended by the actuator manufacturer with 1.25 safety factor. Time required for the operator's full stroke shall not exceed 1 minute. The electric damper motors shall be fail safe spring return and shall open the damper to open position during electric power failure. Damper motors shall be UL certified and equipped with auxiliary contacts.

2.07 CERTIFICATION

- A. Dampers shall bear the AMCA certified ratings seal for both air leakage and performance.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Align and install dampers in accordance with SMACNA standards and the manufacturer's recommendations.
- B. Damper motors installation and electrical and control wiring shall in accordance with the manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

- A. Test each damper to assure operation through its full range of movement without binding or interference. Final damper adjustments and positioning shall be performed during system balancing.
- B. Multiple blade dampers shall be manually tested, prior to installation and following installation.

3.03 TRAINING

- A. The manufacturer shall provide a minimum of one 1/2-hour training session, as specified in Section 01660. Coordinate training sessions with Project Representative. Conduct one training session per week on consecutive weeks to accommodate the shift schedules of operation and maintenance staff.
- B. Coordinate training for all HVAC systems to eliminate redundancies between HVAC and systems.

END OF SECTION

SECTION 15912

FIRE DAMPERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies all fire dampers for heating, ventilating and air conditioning systems.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
SMACNA	HVAC Duct Construction Standards--Metal and Flexible
SMACNA	Fire Damper Guide
UL 555	Standard for Fire Dampers
UL 555S	Leakage Rated Dampers for Use in Smoke Control Systems

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Catalog data and dimensional drawings.
- C. Shop drawings.
- D. Spare Parts: Section 01750.

1.04 CERTIFICATION

- A. Fire dampers shall be labeled by UL or other approved laboratory and constructed in accordance with NFPA 90A requirements.

PART 2 PRODUCTS

2.01 OPERATING REQUIREMENTS

- A. Each fire damper shall cause a pressure drop of not more than 0.05-inch water column at an air velocity of 1500 feet per minute through the device.
- B. Unless otherwise indicated, each damper shall have the same fire-stop rating as the surrounding structure in which it is installed.

2.02 ACCEPTABLE MANUFACTURERS

- A. Ruskin.
- B. Safe-Air.
- C. Air Balance.
- D. Approved Equal.

2.03 MATERIALS

Component	Material
Frame	Galvanized steel
Curtain	Galvanized steel
Sleeve	Galvanized steel
Blades	Galvanized steel

2.04 FIRE DAMPERS

- A. General:
 - 1. Fire dampers shall be the curtain type, with blades out of the air stream.
 - 2. Fire damper frame shall be 20-gage channel.
 - 3. The blades shall be 24-gage, interlocked to form a curtain across the frame opening. The damper blades shall be held in place by fusible links rated for 165 degree F temperature operation.
 - 4. Fire damper sleeves shall be the same gage as the connecting ductwork.
- B. Access Door:
 - 1. An access door shall be provided for each fire damper assembly.
 - 2. The access door and frame shall be constructed in accordance with SMACNA standards, of metal of the same or heavier gage thickness as the ductwork.
 - 3. The door frame shall be clinch locked or tee locked to the duct.
 - 4. The access door shall be 1 inch smaller than the duct opening and shall be provided with an airtight seal.

2.05 SPARE PARTS

- A. Procedures: Section 01750.
- B. Provide a quantity of 10 percent extra fusible links of each variety and operating characteristic used on the Project.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Fire Dampers:
 - 1. Install fire dampers in ductwork penetrating fire-rated walls, floors and ceilings as required by the building code and the local authority.
 - 2. Electrolytically isolate fire dampers using a dielectric material when installing in ductwork systems constructed of aluminum or stainless steel.
 - 3. Fire damper sleeve connections shall be as specified in SMACNA standards.

- B. Access Openings:
 - 1. Provide an access opening in ductwork attached to each fire damper.
 - 2. The access opening shall be large enough to permit inspection and resetting of the fire damper it serves.
 - 3. Provide an access door to cover the access opening.
 - 4. Stencil each access door "FIRE DAMPER ACCESS" with 2-inch high red letters.

3.02 FIELD QUALITY CONTROL

- A. Fire Dampers: disconnect the fusible link and operate the fire damper several times to assure proper, unobstructed operation.

END OF SECTION

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SECTION 15990

HVAC SYSTEM TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.01 SUMMARY

- A. This Section specifies the labor and services necessary to test, adjust, and balance under actual operating conditions and air systems design flow rates.

1.02 QUALITY ASSURANCE

- A. Referenced Standards: This Section incorporates by reference the latest revision of the following documents. These references 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.

<u>Reference</u>	<u>Title</u>
AABC	Associated Air Balance Council, National Standards for Total System Balance
ASHRAE 70	Standards--Methods of Testing for Rating the Air Flow Performance of Outlets and Inlets
NEEB	National Environmental Balancing Bureau, Procedural Standards for Testing Adjusting and Balancing of Environmental Systems

- B. Testing Agency: Procure the services of an independent air balancing and testing agency, belonging to the AABC or the NEBB, to perform balancing, testing and adjustment of systems. One organization shall perform the testing and balancing services.
- C. Codes and Standards:
 - 1. Comply with applicable procedures and standards of the certification sponsoring association:
 - a. National Standards for Field Measurements and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems, AABC.
 - b. Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, NEBB.
 - c. Method of Testing for Rating the Air Flow Performance of Outlets and Inlets, ASHRAE.
 - 2. Calibration and maintenance of instruments and accuracy of measurements shall comply with the requirements of the standards.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Balancing report.

1.04 SPECIAL REQUIREMENTS

- A. Tests and adjustments shall include the complete testing and balancing of heating, ventilating, and air conditioning systems and necessary adjustments to the heating, air conditioning, and ventilating equipment to accomplish the specified design flow rates.
- B. Should any apparatus, material or work fail to meet the specified requirements in these tests, make the necessary corrections and retest the apparatus, material, or work at no additional cost to the County.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Following completion of testing and balancing, leave the system in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.02 PERFORMANCE OF WORK

- A. General: Perform testing, adjusting, and balancing after the system installation is complete but prior to acceptance of the project.
- B. Measurements:
 - 1. Measure and adjust air supply and exhaust units to deliver at least 100 percent of the design air volume at 100 percent cooling.
 - 2. Measure static air pressure conditions on fans, including filter and coil pressure drops, and total pressure across the fan.
 - 3. Adjust fan speeds and motor drives within drive limitations, for required air volume. Set a speed to provide air volume farthest distance from the fan without excess static pressure. Check draw amps of fans on initial start-up. If running amps exceed nameplate, shut off motor immediately, notify Project Representative, and make necessary drive changes as directed.
 - 4. Measure airflow rates with supply, return, and exhaust systems operating with heating and cooling coils wet, with filter bank resistance midway between design values specified for clean and dirty filters with auxiliary systems in operation.
 - 5. Airflow rates supplied, exhausted, or returned shall be within plus or minus 5 percent of the design values specified.
- C. Systems to be Balanced: Balance all heating, ventilating, and air conditioning and foul air equipment and systems.

3.03 BALANCING

- A. General: Characteristics to be tested and adjusted to conform to the values specified include the following:
 - 1. Total airflow rates delivered by fans and air-handling units.
 - 2. Flow rates at all grilles, registers, diffusers, supply and exhaust and return ducts.
 - 3. Capacity and temperature rise or drop across each heating and cooling coil.
- B. Air Flow Rate Measurements:
 - 1. Airflow rates shall be obtained by adjustment of the fan speeds, dampers, or registers. All flow rates shall be measured with supply, return, and exhaust systems operating with heating and cooling coils wet, with filter bank resistance midway between the design values specified for clean and dirty filters, with auxiliary systems in operation and with all doors and windows closed.
 - 2. Flow rates at grilles, registers, branch ductwork and air distribution patterns shall be tested in strict accordance with ASHRAE Standard 70.

3.04 BALANCING REPORT

- A. Report Data: The final certified balancing report shall include the following actual field-verified data:
 - 1. Equipment data:
 - a. Manufacturer and model, size, arrangement, class, location, and equipment number.
 - b. Motor horsepower, voltage, phase, and full load amperage.

- c. Fan cfm, static pressure, rpm, and operating motor BHP.
 2. Duct size, supply or exhaust recorded cfm, velocity, pressure measurements, and location of all measurements.
- B. Report Requirements:
 1. Each individual final reporting form shall bear the signature of the person who recorded the data and that of the supervisor of the reporting organization.
 2. All instruments which were used shall be listed and identified including the last date each was calibrated.
- C. Final Report: Final report shall be submitted prior to Contractor's request for final inspection. In addition to providing all specified data and information on applicable reporting forms, report shall include the following:
 1. A schedule for testing and balancing parts of the systems which must be delayed due to seasonal, climatic, occupancy, or other conditions beyond control of the Contractor. Delayed work shall be completed as early as the proper conditions will allow, after consultation with the Project Representative.
 2. Due to delayed testing, reports shall be submitted after execution of those services.
 3. A total balance report shall include the following components:
 - a. General Information and Summary.
 - b. Instrument Calibration.
 - c. Air Systems.
 - d. Record drawings with specified and measured flow rates.

3.05 FINAL INSPECTION

- A. Following acceptance of the reports by the Project Representative, permanently mark all damper positions so that they can be restored to their correct position if disturbed at any time. If a balancing device is provided with a memory stop, set it and lock it. Do not mark devices until after final inspection.

END OF SECTION

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