

**SECTION 15060
PIPE AND PIPE FITTINGS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish and install all materials, equipment and appurtenances necessary for the complete and satisfactory installation of all piping systems, including tubing systems, as shown on the drawings and as required for a complete installation as specified herein.
- B. This Section applies to all interior, exterior, buried, and exposed (non-buried) piping and tubing systems. This Section also applies to all chemical-related piping and tubing.
- C. The Contractor shall provide all labor, materials, equipment and services necessary to install the piping systems as specified herein and as shown on the Contract Drawings.

1.02 GENERAL REQUIREMENTS

- A. Sizes shown are nominal diameter, unless indicated otherwise.
- B. Drawings do not show all fittings, offsets, unions, hangers, supports, and other appurtenances. Provide as required and show on shop drawings.
- C. Verify exact dimensions of valves, fittings, and equipment to assure Work will fit together properly and conform to the general arrangement shown on the Drawings.
- D. Determine the following prior to fabricating piping systems:
 - 1. Determine dimensions required to correctly locate pipe.
 - 2. Determine dimensions required to fit pipe to equipment and valves.
 - 3. Proper location and orientation of pipe sleeves and wall castings.
 - 4. Determine dimensions required to avoid obstructions and conflicts with other Work.
- E. Use the actual dimensions of equipment to which connections will be made, and the indicated dimensions on the drawings, as a guide in selecting laying lengths of pipes and fittings.
- F. When connecting to existing piping:

1. Do not reuse existing gaskets, bolts, pipes, or fittings.
 2. Field verify the exact point of connection to the existing pipe.
- G. For small piping systems (<4"), the drawings do not necessarily show all fittings, offsets, unions, hangers, supports, etc. All such items shall be furnished and installed, however, as required for complete and satisfactory installation of the equipment shown.
- H. Piping for plumbing and HVAC systems is specified in other sections of the specifications.
- I. The Contractor shall verify all dimensions of valves, special castings and fittings, pipe equipment, etc., so that all of the pipe work performed will fit together properly and will conform to the arrangement as shown on the drawings. In selecting laying lengths of fittings, the Contractor shall be guided by the dimensions of equipment to which connections are made and by the indicated dimensions on the drawings. All pipe and specials shall be accurate to the dimensions shown. Hubs, spigots, and flanges shall be at right angles to the axis of the opening, and openings shall be at the exact angle specified.

1.03 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02200 – Earthwork
- C. Section 09900 – Painting
- D. Section 11100 – General Process Mechanical Requirements
- E. Section 15080 - Valves and Piping Specialties
- F. Section 15094 – Pipe Supports
- G. Section 15190 - Testing Piping Systems

1.04 QUALITY ASSURANCE

- A. Reference Standards
 1. American Welding Society (AWS).
 - a. AWS 2.4, Standard symbols for welding, brazing and nondestructive examination
 - b. AWS B2.1, Welding Procedure and Performance Qualifications
 - c. AWS D1.1, Structural Welding Code - Steel
 - d. AWS D10-9, Qualification of welding procedures and welders for piping and tubing
 - e. AWS QC1, Standard for AWS Certification of Welding Inspectors
 2. American Society of Mechanical Engineers (ASME).
 - a. Boiler and Pressure Vessel Codes (BPVC)

- b. ASME B31.3, Chemical Plant and Petroleum Refinery Piping
 - c. ASME B31.2, Fuel Gas Piping
 - d. ASME B31.8, Gas Transmission and Distribution Piping Systems
3. American National Standards Institute (ANSI).
- a. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800
 - b. ANSI B16.3, Malleable Iron Threaded Fittings Class 150 and 300
 - c. ANSI B16.5, Pipe Flanges and Flanged Fittings
 - d. ANSI B16.9, Factory-Made Wrought Steel Buttwelding Fittings
 - e. ANSI B31, Code for Pressure Piping
 - f. ANSI B31.2, Fuel Gas Piping
 - g. ANSI B31.3, Chemical Plant and Petroleum Refinery Piping
 - h. ANSI B31.8, Gas Transmission and Distribution Piping Systems
4. American Water Works Association (AWWA).
- a. AWWA C104, Cement-mortar lining for ductile-iron pipe and fittings for water
 - b. AWWA C110, Ductile-iron and gray-iron fittings, 3 in. Through 38 in. For water and other liquids
 - c. AWWA C111, Rubber-gasket joints for ductile-iron pressure pipe and fittings
 - d. AWWA C115, Flanged ductile-iron pipe with threaded flanges
 - e. AWWA C150, Thickness design of Ductile-iron pipe
 - f. AWWA C151, Ductile-iron pipe, centrifugally cast, for water and other liquids
 - g. AWWA C606, Grooved and shouldered joints
5. Steel Structures Painting Council (SSPC)
- a. SSPC-SP-1, Solvent Cleaning
 - b. SSPC-SP-3, Power Tool Cleaning
6. American Society for Testing and Materials (ASTM)
- a. ASTM A 48, Specification for Iron Castings
 - b. ASTM A 53, Specification for Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - c. ASTM A 74, Specification for Cast Iron Soil Pipe and Fittings
 - d. ASTM A 105, Specification for Carbon Steel Forging for Pipe Components
 - e. ASTM A 106, Specification for Seamless Carbon Steel Pipe for High-Temperature Service
 - f. ASTM A 126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
 - g. ASTM A 182, Specification for Forged Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
 - h. ASTM A 183, Specification for Carbon Steel Track Bolts and Nuts
 - i. ASTM A 193, Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service

- j. ASTM A 194, Specification for Alloy Steel Nuts for Bolts for High Pressure and High-Temperature Service
 - k. ASTM A 197, Specification for Cupola Malleable Iron
 - l. ASTM A 234, Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
 - m. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
 - o. ASTM A 536, Specification for Ductile Iron Castings
 - p. ASTM A 563, Specification for Carbon and Alloy Steel Nuts
 - q. ASTM B 32, Specification for Solder Metal
 - r. ASTM D 1784, Specification for Rigid PVC Compounds and CPVC Components
 - s. ASTM D 1785, Specification for PVC Plastic Pipe, Schedules 40, 80, and 120
 - t. ASTM D 2997, Specification for Centrifuagally Cast "Fiberglass" Pipe
 - u. ASTM D 3517, Specification for "Fiberglass" Pressure Pipe
 - v. ASTM D 3567, Practice for Determining Dimensions of "Fiberglass" Pipe and Fittings
 - w. ASTM F 437, Specification for Threaded CPVC Plastic Pipe Fittings, Schedule 80
 - x. ASTM F 439, Specification for Socket Type CPVC Plastic Pipe Fittings, Schedule 80
 - y. ASTM F 441, Specification for CPVC Plastic Pipe, Schedules 40 and 80
 - z. ASTM F 493, Specification for Solvent Cements for CPVC Plastic Pipe and Fittings
 - aa. ASTM A403, Specification for Wrought Austenitic Stainless Steel Piping Fittings.
- B. Install piping to meet the requirements of state and local building codes and in accordance with PFM of TW, Va.
- C. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuels, aromatic compounds, paint solvent, paint thinner, or acid solder will be rejected.
- D. All contractor personnel that will prepare solvent cemented joints for PVC shall be qualified for such bonding practices according to the bonding qualification procedure described in ASME B 31.3, Chapter VII for bonding of plastic piping.

1.05 SUBMITTALS

- A. The following items shall be submitted with the Shop drawings in accordance with, or in addition to, the submittal requirements specified in Section 01300 - Submittals.
- 1. Manufacturer's product data, specifications, and installation instructions.

2. Detailed shop drawings for system material and equipment. Show complete information concerning fabrication, installation, anchoring, fasteners and other details.
 3. Fabrication drawings for shop fabricated piping.
 4. Layout drawings for each piping system, indicating the following as a minimum:
 - a. Piping material, class, grade and joint type.
 - b. Anchors, supports, hangers, saddles, straps, and other accessories.
 - c. Fittings, couplings, joints, and joint harnesses.
 - d. Centerline elevations.
 - e. Location, size, and type of anchor bolts.
 - f. Wall and floor penetrations, including sleeves, castings, sealant, escutcheons, and other accessories.
 - g. Bill of materials.
 - h. Orientation of valves and valve operators.
 - i. Critical clearances.
 - j. Thrust restraints - Details to include materials, sizes, assembly ratings, and pipe attachment methods.
 - k. Expansion compensation.
 - l. Insulation.
 - m. Pipe coatings.
 - n. Pipe identification.
 - o. Valve tags and tag numbers.
 - p. Miscellaneous details required for complete installation and understanding.
 5. Thrust restraint system details, as applicable.
 6. For all chemical flexible tubing and tubing fittings, submit documentation from the manufacturer, either by general brochure/literature or by special letter, explicitly stating that the flexible tubing and tubing fittings are suitable for the particular chemical and chemical concentration for which it is installed, and that the fitting type used is compatible with the tubing.
 7. Approval of the shop drawings will not relieve the Contractor of any responsibility for accuracy of dimensions and detail.
- B. Submit manufacturer's instructions for installation of adapters and assembly of mechanical and push-on joints, including the manufacturer's maximum recommended deflection per joint.
- C. Quality Control Submittals:
2. Piping system test reports, including the following:
 - a. Pipe pressure tests.
 - b. Valve tests.
 - c. Dielectric joint tests.

- 5. Certificates:
 - a. Manufacturer's certification of compliance for each pipe material.

D. Contract Close-out Submittals:

- 1. Project Record Documents.
- 2. Operating and Maintenance Manuals, including warranty information.

1.06 PRODUCT DELIVERY HANDLING AND STORAGE

- A. During loading, transporting, unloading, and storage on site, exercise care to prevent damage to piping materials.
- B. Do not drop pipe or fittings.
- C. Store materials on site in enclosures or under protective coverings.
- D. Assure that materials are kept clean and dry; do not store materials directly on the ground.

1.07 REGULATORY REQUIREMENTS

- A. Materials and coatings used in the construction of any pipe or pipe fitting in contact with process water, chemicals, or potable water shall be NSF 61 Certified and approved for use in potable water installations.

PART 2 - PRODUCTS

2.02 GENERAL NOTES – FITTINGS

- A. All fittings shall be of the type indicated on the drawings unless otherwise specified. Ductile iron piping shall be provided with ductile iron fittings; carbon steel piping shall be provided with carbon steel fittings; C/PVC pipe shall be provided with C/PVC fittings, copper tubing shall be provided with bronze, wrought copper or brass fittings.
- B. Nipples shall be extra heavy of same material as piping system in which they are installed. Close nipples are not acceptable.
- D. Except for near connections between chemical tubing and rigid piping, wherever the sizes of pipes are reduced, the fittings shall be "reducers" made to suit these changes without the use of bushings.
- E. All flanges shall come fairly face to face, the pipe in perfect line, the pipes shall not be sprung to make a joint. Gaskets for flanged joints shall be as specified under "Joints". All joints shall be neatly made and with great care.

- F. In general, soft copper tubing shall have flared type fittings, and hard copper tubing shall have soldered joint fittings, or “swagelok” for 1” tubing or less.
- H. Screwed type systems shall contain ample unions in piping at equipment to allow easy removal of the equipment.

2.03 DUCTILE IRON PIPE AND FITTINGS

A. General

1. All ductile iron pipe shall be manufactured per AWWA C150.
2. All ductile iron joints shall adhere to AWWA C111.
3. Pipe and fittings shall be cement-mortar lined inside per AWWA C104, with curing to be effected by an application of a bituminous seal coating which shall cover and seal the cement mortar. The thickness of the cement lining shall be “Double Thickness”, which is double the standard thickness.
4. Ductile iron pressure pipe shall be made of ductile iron of good quality and of such character as shall make the metal casings strong, tough and of even grain and soft enough to satisfactorily permit drilling, tapping and cutting. All piping shall be smooth, free from scale, lumps, blisters, and sand holes and defects of every nature which make it unfit for the use intended. All piping shall be straight and shall be true circles in section with its inner and outer surfaces concentric. No plugging, filling, burning-in or welding shall be allowed. All piping shall be subject to inspection and approval by the Engineer upon delivery, and no broken, cracked, misshaped or otherwise damaged or unsatisfactory piping will be accepted.
5. Each piece of pressure ductile iron pipe shall have the weight and class designation conspicuously painted on it as near as possible to flange or bell end of the pipe and these designations shall be clearly legible.
6. Where required or shown, the Contractor shall provide ductile iron specials. Specials shall in general consist of spool pieces, less than standard lengths of flanged, spigot end, or bell end pipe, or combination of ends, and nonstandard fittings. The specials shall conform in material, thickness and finish to the pipe in which they are installed. Taped reinforced bosses shall be provided as an integral part of fittings, when shown or specified.

B. Buried Pipe

1. All pipe shall be manufactured and supplied in accordance with AWWA C151.
2. All pipe sizes shall be Class 54 greater.

3. Pipe and fittings shall be asphaltic coated.
4. Fittings
 - a. All ductile iron fittings and specials shall be manufactured in accordance with AWWA C110 generally, or AWWA C153 for compact fittings.
 - b. The pressure rating for ductile iron fittings shall be the same as that for the main pipe.
5. Joints
 - a. Buried joints shall be restrained, mechanical joint type. Using Megalugs or similar restraint as approved by the Engineer.
 - d. All buried nuts, bolts, and other associated hardware shall be 316 SS or steel coated in fluoropolymer, FluoroKote#1 by Metal Coatings Corp., or approved equal.

B. Exposed Pipe

1. Unless otherwise stated on the Drawings, all pipe shall be manufactured and supplied in accordance with AWWA C115.
2. All ductile iron pipe shall be Class 54 or greater.
3. Pipe and fittings shall not be asphaltic coated. Pipe and fittings shall be supplied with the manufacturer's shop prime coat of paint which shall be compatible with the final field coat of paint. Pipe and fittings shall receive final field painting per Section 09900 - Painting.
4. Fittings
 - a. All ductile iron fittings and specials shall be manufactured in accordance with AWWA C110 generally.
5. Joints
 - a. All joints shall be flanged. Flanges may be cast integrally with the ductile iron pipe or screwed on type. Pipe compound of the manufacturer's recommendation shall be used at each threaded joint on flanges.
 - b. Interior flanged joints shall have hot dipped galvanized carbon steel nuts, bolts, and other associated hardware.
 - c. Exterior flanged joints shall use nuts, bolts, and other associated hardware which is either 316 stainless steel or carbon steel coated in fluoropolymer, FluoroKote#1 by Metal Coatings Corp., or approved equal.

2.07 BLACK AND GALVANIZED STEEL PIPE (GENERAL USE)

- A. Pipe: ASTM A53, Seamless. Schedule 40, unless otherwise indicated on the contract drawings.
- B. Fittings
 - 1. Threaded: Malleable Iron, ANSI B16.3, 150# Class
 - 2. Flanged: Cast Iron, ANSI B16.1, 125# Class
 - 3. Socket Welded: Forged Steel, ANSI B16.11.
- C. Unions: Threaded, Forged Carbon Steel, MSS SP-83.

2.08 COPPER PIPE

- A. Pipe: ASTM B42, Seamless, Regular Weight, Temper H80
 - 1. H80 - Hard Drawn, 1/8" - 2" dia.
- B. Tubing: ASTM B88, Seamless, Temper H, Type K
- C. Fittings
 - 1. Wrought Copper and Bronze, Solder Joint: ANSI B16.22
 - 2. Cast Bronze, Solder Joint, Pressure: ANSI B16.18
 - 3. Cast Bronze, Threaded: ANSI B16.15, 125# Class
 - 4. Bronze Flanges/Flange Fittings ANSI B16.24, 150# Class
 - 5. Cast Bronze, for Flared Copper Tube: ANSI B16.26
- D. Brazing Filler Material: AWS 5.8.
- E. Brazing Flux: Federal Specification O-F-499, Type B.
- F. Soldering Flux: Federal Specification O-F-506, Type I.
- G. Joints in copper tubing or pipe shall be made using 95-5 tin-antimony solder conforming to ASTM B32.

2.09 POLYVINYL CHLORIDE (PVC) PROCESS PIPE (12" NOMINAL PIPE SIZE AND SMALLER)

- A. Material shall be ASTM D2241, PVC 1120 (12454-B) or PVC 1220 (12454-C) or PVC 2120 (14333-D).

- B. PVC pipe and fittings shall be manufactured from virgin rigid PVC vinyl compounds and shall be Type 1 Grade 1 conforming to ASTM D 1784 and D 1785. Fittings shall conform to the following standard specifications:
 - Socket Type (Schedule 40); ASTM D 2466
 - Socket Type (Schedule 80); ASTM D 2467
 - Threaded Type (Schedule 80); ASTM D 2464
- C. Fittings shall generally be socket cement weld type, but may be flanged or threaded type only as needed to connect to valves, adapters, equipment, and appurtenances.
- D. Flanged fittings shall be of the same material as the specified pipe and material conforming to ANSI B16.5. Gasket materials shall be suitable for the chemical application.
- E. Non-chemical Applications: solvent cement for socket type joints shall conform to ASTM D 2564 for PVC pipe and fittings.
- F. Chemical Service joints require special materials. All socket type, solvent cement joints for all chemical service piping and fittings shall utilize primer and cement which is specially formulated for chemical resistance and which is suitable for bleach (sodium hypochlorite) application, even if the particular application is not bleach. Only cements and primers which have documented performance testing with bleach, caustic soda, and strong acids from an independent third party laboratory testing at at least 100 psi for 2,500 hours shall be considered for approval. Use IPS Weld-On CPVC 724 cement and IPS Weld-On P-70 primer for all chemical applications, pressurized and non-pressurized, or approved equal.

2.10 CHLORINATED POLYVINYL CHLORIDE (CPVC) PROCESS PIPE (12" NOMINAL PIPE SIZE AND SMALLER)

- A. CPVC shall be manufactured in accordance with ASTM D 1785, D 1784 and F 441, "normal impact" pipe, Schedule 40 or 80 as specified.
- B. Fittings used with this pipe shall be socket type or flanged type as specified herein or indicated on the Drawings.
- C. CPVC pipe shall be Type 4, Grade 1, Schedule 80, conforming to ASTM D 1784 and ASTM F 441. CPVC fittings shall be socket type conforming to ASTM F 439.
- D. Solvent cement for socket type joints shall conform to ASTM F 493 for CPVC pipe and fittings.

2.11 POLYVINYL CHLORIDE (PVC) PROCESS PIPE (LARGER THAN 12" NOMINAL PIPE SIZE)

- A. **Gravity Sewer Pipe and Fittings**
 - 1. Pipe 15" Diameter and Smaller: **ASTM D3034, SDR-35.**

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| 2. | Pipe 18" to 27" Diameter: | ASTM F679, SDR-35 |
| 3. | Flexible Elastomeric Seals: | ASTM D3212 |
| 4. | Seal Material: | ASTM F477 |

2.12 PVC DOUBLE WALL CONTAINMENT PIPING SYSTEM

- A. The PVC double wall piping system shall be a pre-fabricated containment piping system as manufactured by (Guardian Systems, MI) Division of IPEX Industrial, or approved equal. The system shall be designed, fabricated, installed and tested in accordance with manufacturer's recommendations and as specified herein and shall be suitable for the intended chemical service. Manufacturer shall have a minimum of five (5) years experience in manufacturing double containment piping systems. Contractor shall not design and or fabricate the piping system.
- B. Each contained piping system shall consist of gray Schedule 80 PVC primary piping system supported within a gray Schedule 80 PVC secondary containment piping system. PVC materials shall meet requirements of the above subsection on general PVC pipe and fittings. Carrier fitting sizes ½" through 4" will utilize Centra-Lok molded supports minimizing the number of (factory assembled) carrier fitting joints. Each system shall be provided with suitable drains and vents and be designed to provide complete drainage of the secondary containment piping. Interstitial supporting devices shall be made from Polypropylene Centra-Guide supports and shall be provided within the secondary containment pipe. Supports shall be designed to allow continuous drainage in the annular space to the drain points.
- C. All joints shall be solvent welded cement type. All solvent cement and primer for primary and secondary piping shall be specially designed for chemical applications and be that which is described in the above subsection on general PVC joints for chemicals (IPS Weld-On or approved equal).

2.13 PVC TUBING AND FITTINGS

- A. PVC tubing shall be clear braided reinforced and flexible, with an inner and outer wall. Nylon reinforcing braid shall be completely bonded within the inner and outer wall to eliminate ballooning, bursting and separating of the tubing. Inner and outer wall surfaces shall be smooth and free from abrasions to reduce material buildup.
- B. All tubing and fittings shall have a working pressure of at least 100 psi.
- C. Fittings shall be rigid PVC, barbed insert type. Secure joints with stainless steel clamps, two on each barbed insert, rotated 180° apart.
- D. See submittal section above for requirements of verifying chemical suitability for tubing and fittings.

2.17 POLYETHYLENE (PE) TUBING AND FITTINGS

- A. PE tubing shall be flexible and suitable for the chemical application.
- B. All tubing and fittings shall have a working pressure of at least 100 psi.
- C. See submittal section above for requirements of verifying chemical suitability for tubing and fittings, and for verifying compatibility of fittings type and tubing type.

2.18 CAST IRON SOIL PIPE

- A. Pipe and Fittings: ASTM A74, Service Class. Hub and Spigot or Double-Hub.
- B. Joints: Double-Seal Compression Gaskets
 - 1. Gaskets: ASTM C564

2.20 JOINTS

- A. General
 - 1. All joints at equipment shall conform to the equipment requirements. No direct welded connections shall be made to valves or other equipment. Right and left couplings, long screws, or caulking of pipe threads or gasket joints will not be permitted. Mitered joints for elbows and matching straight runs of pipe for tees or elbows will not be permitted.
 - 2. Soldered or brazed joints shall be made with solder and a noncorrosive paste flux. The solder mixture shall be of 95-5 (tin-antimony) content. The use of acid core solder shall not be permitted. The application of excess heat shall be avoided to prevent undue softening or burning of the fittings or tubing when making connections. All soldering operations shall be performed in strict accordance with best accepted practices. Tubing shall be square cut and reamed to remove all burrs. The inside of the fittings and the outside of the tubing at each end shall be well cleaned immediately prior to soldering to remove all traces of oxidation, regardless of how clean the surfaces of the pipe and fittings may appear.
 - 3. Threads shall be standard, clean-cut and tapered. All pipe shall be teamed free from burrs and kept free from scale and dirt. Unless otherwise specified, non-chemical application threaded joints shall be made up with "Permatex" type 2, black, nonhardening pipe joint compound applied to the male thread only. The use of red lead or white lead will not be permitted. The complete threaded joint shall not have more than two threads exposed when made tight. Threads shall comply with ANSI B2.1.
 - 4. Except where special couplings are indicated, piping requiring screwed connections shall be connected with screwed, malleable iron, ground joint, brass seat, 150 psi unions; for piping requiring flanged connections,

flanged malleable iron unions shall be used. The finish of all unions shall match piping in which they are installed. Unions shall be provided at equipment and where required otherwise to facilitate removal of piping or equipment.

6. Flanges shall be of the same material as the piping on which installed. Heads, nuts and threads shall be U.S. Standard sizes. Bolts shall be of such length as to project $\frac{1}{4}$ inch beyond the nut when the flanged joint with gasket is assembled. Unless otherwise specified in the individual sections, all metallic hardware shall be as follows:
 - a. Flanged Interior Pipe, general non-chemical: Hot Dipped Galvanized Carbon Steel
 - b. Flanged Exterior Pipe, general non-chemical: 316 Stainless Steel.
 - c. Alum, caustic soda, and sodium hypochlorite: Polyethylene-coated Titanium.
 - d. Fluoride and Polyphosphate: Polyethylene-coated Hastelloy C.
7. For chemical applications, joint gaskets shall be:
 - a. Alum and Caustic Soda: EPDM.
 - b. Sodium Hypochlorite, Fluoride, and Polyphosphate: Viton.

B. Flexible Couplings

1. Unless specified or shown otherwise on the drawings, flexible couplings shall be the Style 38 of the M&H Manufacturing Division, No. 411 or 441 of Rockwell International, or equal. Each shall be so designed and constructed to withstand an internal line pressure equal to that of the pipeline in which it is to be installed. The various flexible couplings shall be suitable for the class and size of ductile iron pipe or steel pipe as required at the various locations, and shall be without pipe stops. The Contractor shall provide and install flexible couplings in addition to those shown, as required, for flexibility in installing the various piping systems. Locations of additional couplings shall be as directed by the Engineer.
2. Harnesses shall be provided across all flexible couplings and all flanged adapters.

C. Flange Coupling Adapters

1. Flanged coupling adapters shall be furnished as required and as shown on the Drawings for joining plain-end pipe to flanged valves, fittings and pumps. They shall be flanged on one end and have gasketed coupling on the other end.
3. Pressure rating shall be the same as the rating on the connected piping.
4. Materials shall be ductile iron or steel.

5. Flanged adapters shall be shop primed with a premium quality primer compatible with the field paint system specified in Section 09900 - Painting. Field painting of wetted area shall be done prior to installation.
6. T-head bolts and nuts shall be low alloy steel.
7. Restrained flanged coupling adapters 12" and smaller shall be restrained by heat treated lugs on the gland which grip the pipe. Restrained flanged coupling adapters larger than 12 inches in diameter shall be harnessed by tying the adapter to the nearest pipe joint flange using threaded rods and rod tabs.
8. Flanged adapters shall be as manufactured by Dresser Industries, Style 127 or 128, Smith Blair Corporation, or equal. Restrained Flanged Coupling Adapters shall be as manufactured by Romac Industries, Inc., or approved equal.

E. Sleeve Type Couplings

1. Sleeve type, flexible couplings of the double-ring, steel follower, rubber compounded wedge-gasketed, steel flared middle ring type shall be furnished and installed where shown on the Drawings or otherwise required to resist internal operating pressures. In addition to that specified herein, harnessed, sleeve type flexible couplings shall be provided on all exposed pipe 3 inches and larger in diameter that spans any expansion joint in a building or structure.
2. Materials shall be of high strength steel and couplings shall be rated for the same pressures as the connecting piping.
3. Gaskets shall be rubber. Bolts and nuts shall be alloy steel, corrosion-resistant and prime coated.
4. Couplings shall be shop primed with a premium quality primer compatible with the painting system specified in Section 09900 - Painting. Field painting of wetted area shall be done prior to installation.
5. Harnessing
 - a. Harness couplings to adjacent flanges as shown, specified or otherwise required to restrain all pressure piping.
 - b. Dimensions, sizes, spacing and materials for lugs, tie rods, washers, and nuts shall conform to the standards for the pipe size, and design pressure specified.
 - c. No less than two (2) bolts shall be furnished for each coupling.
 - d. Tie bolts, nuts and washers shall be ASTM A 193, Grade B7 steel or better.

- e. Harness rods shall have lengths less than 10 feet between adjacent flanged joints on fittings and shall be coated in accordance with Section 09900 – Painting.
 - 6. Couplings shall be as manufactured by Dresser Industries, Style 38, or equal as required and shown on the Drawings. All couplings shall be provided without interior pipe stop.
- F. Transition Couplings
- 1. To connect pipes of different outside diameters.
 - 2. High-grade steel middle ring with ductile iron follower flanges with rubber compounded wedge section gaskets. Mechanical Joint, ANSI/AWWA C111/A21.11.
- G. Solid Sleeve Couplings
- 1. Solid sleeve couplings shall be used to connect buried service piping where shown on the Drawings. Solid sleeves shall be ductile iron, long body and shall conform to the requirements of ANSI A21.10 (AWWA C110). Unless otherwise shown or specified, solid sleeve couplings shall be Style A11760 as manufactured by American Cast Iron Pipe Co., or equal.
- I. UNIONS
- 1. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.
 - 2. For copper piping, unions shall have ground joints and conform to ANSI B16.18.
 - 3. For PVC and CPVC piping, unions shall be socket weld type.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Install all materials and piping in full accordance with the manufacturer's recommendations for installation. No field bending or distortion of the pipe is permitted.
- B. Buried Pipe:
 - 1. Install ductile iron pipe per AWWA C600.

2. Perform trench excavation to the line and grade indicated on the Contract Drawings and as specified in Section 02201 – Trenching, Backfilling and Compacting.
3. Unless otherwise indicated on the Drawings, provide a minimum cover of 4'-0" above the top of piping laid in trenches.
4. Provide pipe bedding as specified in Section 02201 for each type of pipe used.
5. Provide Type IV bedding for all PVC and other plastic pipe. Place aggregate in a manner to avoid segregation, and compact to the maximum practical density so that the pipe can be laid to the required tolerances.

3.02 LAYING PIPE IN TRENCHES

- A. Give ample notice to the Engineer in advance of pipe laying operations.
- B. Use laser alignment equipment during pipe laying operations.
- C. Lower pipe to trench using handling equipment designed for the purpose to assure safety of personnel and to avoid damage to the pipe; do not drop pipe.
- D. Lay pipe proceeding upgrade with the bell or groove pointing upstream.
- E. Lay to a uniform line with the barrel of the pipe resting solidly in bedding material throughout its length; excavate recesses in bedding material to accommodate joints, fittings and appurtenances; do not subject pipe to a blow or shock to achieve solid bedding or grade.
- F. Lay each section of pipe in such a manner as to form a close concentric joint with the adjoining section and to avoid offsets in the flow line.
- G. Pipe Joining
 1. Clean and inspect each pipe and fitting before joining; assemble to provide tight, flexible joints that permit movement caused by expansion, contraction and ground movement.
 2. Use lubricant recommended by the pipe or fitting manufacturer for making joints.
 3. If unusual joining resistance is encountered or if the pipe cannot be fully inserted into the bell, disassemble joint, inspect for damage, reclean joint components, and reassemble joint.
- H. Assemble mechanical joints in accordance with ANSI/AWWA C111/A21.11, Appendix A; if satisfactory seating of the joint is not obtained at maximum torque, disassemble the joint, reclean, and reassemble using a new gasket.

- I. Check each pipe installed as to line and grade in place; correct deviation from grade immediately; deviation from the designed grade and alignment as indicated on the Contract Drawings will be cause for rejection.
- J. Do not deflect joints in pressure piping more than the maximum recommended by the pipe manufacturer.
- K. Place sufficient backfill on each section of pipe, as it is laid, to hold pipe firmly in place.
- L. Clean the interior of the pipe as the work progresses; where cleaning after laying is difficult because of small pipe size, use a suitable swab or drag in the pipe and pull forward past each joint immediately after joining has been completed.
- M. Keep trenches and excavations free of water during construction.
- N. When the work is not in progress, and at the end of each workday, securely plug ends of pipe and fittings to prevent trench water, earth or other substances from entering the pipe or fittings.

3.03 CRADLES AND ENCASEMENT

- A. Provide concrete cradle and encasement for pipeline where indicated on the Contract Drawings; construct in accordance with Standard Detail.

3.04 BACKFILLING TRENCHES

- A. Backfill pipeline trenches only after examination of pipe laying by the Engineer.
- B. Backfill trenches as specified in Section 02221, Trenching, Backfilling and Compacting.
- C. Install detectable utility marking tape above all plastic pressure pipeline, 12" to 18" below final grade.

3.05 INTERIOR PROCESS PIPING INSTALLATION

- A. Pipe Layout in Building
 - 1. Coordinate work to prevent interference between architectural, structural, electrical and mechanical features; the Contract Drawings are generally diagrammatic due to their small scale.
 - 2. Provide such offsets, fittings and other items as may be required to suit conditions.
 - 3. Do not place joints or fittings over switchboards, panels, motors or other electrical equipment.

4. The completed installation shall present a neat, orderly appearance; do not block openings or passageways; run piping parallel to the walls of buildings or structures.
 6. Orient handwheels, levers, valve operators and other valve actuators for convenience of operation; set gate valves with the stem above the horizontal.
 7. Cut pipe to measurements established at the site and install without springing or forcing; make changes in direction with fittings.
- B. Equipment Connections
1. Make connections to pumps and other equipment in a manner to eliminate strains on piping and equipment.
 2. Install unions or flanges adjacent to equipment and wherever their use will facilitate removal of equipment.
- D. Sleeves
1. Unless shown otherwise, all piping passing through walls and floors shall be installed in sleeves or wall castings accurately located before concrete is poured, or placed in position during construction of masonry walls. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise. Water stop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall.
 2. Sleeves shall be cast iron, black steel pipe, or fabricated steel in accordance with details shown on the Drawings. If not shown on the Drawings, the Contractor shall submit to the Engineer the details of sleeves he proposes to install; and no fabrication or installation thereof shall take place until the Engineer's approval is obtained. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS. Steel sleeve surfaces shall receive a commercial sandblast cleaning and then be shop painted in accordance with Section 09900 – Painting.
 3. When shown on the Drawings or otherwise required, the annular space between the installed piping and sleeve shall be completely sealed against a maximum hydrostatic pressure of 20 psig. Seals shall be mechanically interlocked, solid rubber links, trade name "Link-Seal", as manufactured by the Thunderline Corp., Wayne, Michigan, or equal. Rubber link, seal-type, size, and installation thereof, shall be in strict accordance with the manufacturer's recommendations. For non-fire rated walls and floors, pressure plate shall be glass reinforced nylon plastic with EPDM rubber seal and 304 stainless steel bolts and nuts. For fire rated walls and floors, two independent seals shall be provided consisting of

low carbon steel, zinc galvanized pressure plates, silicon rubber seals and low carbon steel, zinc galvanized bolts and nuts.

E. Flanged Joints

1. Tighten flange bolts so that the gasket is uniformly compressed and sealed; do not distort flanges; do not exceed manufacturer's recommended maximum torque.
2. Leave flange bolts with ends projected 1/8" to 1/4" beyond the face of the nut after tightening.

G. Threaded Joints: ANSI B2.1, NPT

1. Cut threads full and clean with sharp dies; ream ends of pipe after threading and before assembly to remove burrs; leave not more than three pipe threads exposed at each connection; for non-chemical application, use joint compound or thread tape on the male thread only.

H. Solder Joints

1. Ream or file pipe to remove burrs; clean and polish contact surfaces of joints.
2. Apply flush to both male and female end; insert end of tube into fittings full depth of socket.
3. Bring joint to soldering temperature, in as short a time as possible, forming continuous solder bead around entire circumference of joint.

- I. Solvent Cemented Joints (PVC): Make joints in pipe and fittings in accordance with the procedures and techniques in ASTM D2855.

3.06 CONNECTION AT DISSIMILAR METALS

- A. Wherever pipes of dissimilar metal join, there shall be provided an insulating union, coupling or flange connector for corrosion control. Connectors shall include an approved type dielectric separator. Connectors shall be the product of Dresser Corporation, or equal. Stainless steel nuts, bolts, and washers shall be used at all places at which such dielectric separators are used.

3.07 PIPE SUPPORTS

- A. Pipe supports and bracing shall be provided as indicated in Section 15094 Pipe Supports.

3.08 TESTING

- A. The following piping systems shall be water pressure tested per AWWA C600 Section 5.2, and at the following test pressures:

Piping System	Test Press. (psi)
Raw Water Piping and Recycle Water Piping	150
All chemical piping and tubing systems which carry liquid chemical. (For tank outlet piping and tubing between the bottom of storage tank and the chemical pump suction, test the chemical line while it is connected to the tank, but close the tank outlet valve. If a piping or tubing system does not have a permanent valve to isolate during the pressure test, utilize a temporary valve or cap to conduct pressure test before making permanent connections). Do not conduct pressure tests while piping/tubing is connected to chemical pump.	100
Raw Water Sample Line	100
Potable Water Service to and inside of Prop. Chemical Building, except piping after a pressure reducing valve	250
Potable Water Service inside Prop. Chem. Bldg. after PRV	150

- B. Cleaning and Testing for Double Wall PVC pipe
1. Upon completion of the installation, the primary piping system shall be pressure tested per the above general requirements. Additionally, the system shall be tested during the installation at intervals to be determined by the manufacturer. All tests shall be done in strict accordance with the recommendations of the manufacturer, including the sequence and duration of such tests.
 2. Upon completion of the installation, the secondary containment piping shall be pneumatically tested at a minimum duration of 2-1/2 hours. The external joints should be soaped and visually inspected for leaks. It is imperative that a working pressure regulator be used during the pneumatic test to insure over pressurization of the PVC beyond 10 psi cannot occur. Also, all precautions should be taken to protect against the hazards of a possible brittle fracture of PVC under compressed gas. Both the preliminary and final test shall be done in strict accordance with the recommendations of the manufacturer, including sequence and duration of such test.
 3. Following installation of the systems, the primary piping system shall be flushed clean. The contractor shall check the operation of all valves.

3.09 DISINFECTION

- A. Disinfect all pipes and accessories in contact with filtered or potable water per AWWA C651.

END OF SECTION 15060

**SECTION 15080
VALVES AND PIPING SPECIALTIES**

PART I – GENERAL

1.01 DESCRIPTION

- A. The work of this section includes, but is not limited to:

Furnish and install all valves, hose connections, hydrants, valve boxes, and other piping specialties as specified, as indicated on the contract drawings, and as necessary to provide complete piping systems as intended that are not expressly specified in other sections of these specifications.

- B. This Section applies to potable water service, nonpotable water service, chemical service, buried installment, exposed (non-buried) installment, interior, and exterior installments.

- C. Related work specified elsewhere:

1. Section 15060 - Pipe and Pipe Fittings
2. Section 11170 - Liquid Chemical Metering Pumps

1.02 QUALITY ASSURANCE

- A. Products shall be new, the latest standard product of reputable manufacturers, and shall have replacement parts available.
- B. Potable water and raw water system materials shall bear the seal of approval of the National Sanitation Foundation (NSF).
- C. Materials contaminated with gasoline, lubricating oil, liquid or gaseous fuels will be rejected.
- D. The manufacturer of each valve shall have a minimum of 5 years of experience in manufacturing the type of valve supplied.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Shop Drawings and Product Data
1. Submit manufacturer's catalog data, literature, illustrations and specifications.
 2. Submit shop drawings of valves and valve operators including dimensions,

net assembled weight of each size valve furnished, construction details, and materials of components.

3. Submit manufacturer's installation instructions.
4. Submit manufacturer's maintenance instructions and complete parts lists.
5. For all chemical valves and pipe specialties, submit documentation from the manufacturer, either by general brochure/literature or by special letter, explicitly stating that the products are suitable for the particular chemical and chemical concentration for which it is installed.

C. Certificates

Submit a Certificate of Compliance, together with supporting data, from the materials supplier(s) attesting that valves, accessories, and specialties meet or exceed specification requirements.

D. Submit post-installation field tests to Engineer.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver valves and accessories to the job site in the manufacturer's boxes or crates. Mark each valve as to size, type and installation location.
- B. Seal valve ends to prevent entry of foreign matter into valve body.
- C. Store valves and accessories in areas protected from weather, moisture and possible damage.
- D. Do not store materials directly on the ground.
- E. Handle valves and accessories to prevent damage to interior and exterior surfaces.

1.05 JOB CONDITIONS

- A. Investigate conditions affecting this work and coordinate with other contractors to prevent interference between architectural, structural, mechanical and electrical features.
- B. The contract drawings for small diameter pipe are generally diagrammatic and it is not possible to indicate all fittings, valves, and other items required for a complete operating system. Provide all such valves, fittings and specialties to complete the systems as intended.
- C. Provide necessary valve wheels, keys, wrenches, levers and stem extensions. Locate to assure accessibility and operability throughout the operating range without interference. Install valve stem supports, guides and operators. Provide valve accessories of the same manufacturer as the valve, unless specified elsewhere.

- D. Provide chain operators for valves 4" size and larger that are located 6'-0" or more above finished floor level.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide valves and piping specialties of the size and type indicated on the contract drawings.
- B. Cast iron valve material shall meet or exceed the requirements of ASTM A126, Class B.
- C. Valve flanges shall conform to ANSI B16.10, (125# and 250# class) as applicable.
- D. Mechanical joint valve ends shall conform to ANSI/AWWA C111/A21.11.
- E. Screwed valve ends shall conform to ANSI B2.1; American Standard Taper pipe threads.
- F. Valves shall be of a design that requires no more than 50 lbs. pull on the handwheel or standard valve wrench to provide positive shutoff against rated working pressure.
- G. All valves and pipe specialties which come in contact with treatment chemicals, potable water, or raw water shall be NSF 61 approved.
- H. For all chemical valves and specialties, at least the following material requirements shall be adhered to for all materials in contact with the chemical. If the manufacturer's chemical resistance guide is more stringent, then the manufacturer's guide shall be followed.

Chemical	Body shall be:	Seats/Seals/Gaskets shall be:	Metal, if any, shall be:
Alum	PVC, CPVC, PP, or PVDF	EPDM or Viton	Titanium if available; if not, then Hastelloy or 316 SS
Caustic Soda	PVC, CPVC, or PP	EPDM or PTFE	Titanium if available; if not, then Hastelloy or 316 SS
Sodium Hypochlorite	PVC, CPVC, or PVDF	PTFE or Viton	Hastelloy C
Fluoride	PVC, PP, or PVDF	Viton or PTFE	Hastelloy C or 316 SS
Polyphosphate	PVC, CPVC, PP, or PVDF	Viton, EPDM, or PTFE	Hastelloy C
Potassium Permanganate	PVC, CPVC, PP, or PVDF	Viton, EPDM, or PTFE	Hastelloy C

Materials shall follow these requirements:

PVC Conforming to ASTM D1784 Cell Classification 12454A
CPVC – Conforming to ASTM D1784 Cell Classification 23567A
PP Conforming to ASTM D4101 Cell Classification PP0210B67272
PVDF Conforming to ASTM D3222 Cell Classification Type II
FKM – Viton® Fluorocarbon Rubber
EPDM – Ethylene Propylene Diene Terpolymer Rubber
PTFE – Teflon® Polytetrafluoroethylene

2.02 GATE VALVES

- A. Flanged, Mechanical Joint, or Push-On Gate Valves
1. Iron body, bronze mounted, solid wedge, tapered seat, non-rising stem, O-ring packing. ANSI/AWWA C509, 250 psi min. working pressure. Open counterclockwise.
 2. Valves shall be provided without bypasses except as noted below.
 3. Gate valves sixteen (16) inches and larger shall be gear operated. Valves fourteen (14) inches and smaller need not be geared.
 4. Valves located higher than six (6) feet above its operating slab shall be chain operated, with the chain extending to within five (5) feet above the slab. Valves located lower than six (6) feet above its operating slab shall be handwheel operated. Extension stems with two inch square operating nuts and steady bearings shall be provided where shown on the drawings. Floor boxes shall be provided where shown on the drawings. All valves shall open with counterclockwise rotation of the handwheel, chainwheel, or extension stem.
 5. All buried gate valves shall have stainless steel exterior bolts.
- B. Threaded and Soldered Gate Valves
1. Threaded or soldered joint.
 2. Bronze body, Class B; non-rising bronze stem, ASTM B584.

2.03 CHECK VALVES

- A. Threaded and Solder Joint Check Valves for Use with Copper or Steel Water Piping, 2" or less:
1. Horizontal swing check type. Bronze body, renewable bronze disc. 200 psi working pressure.
- B. Swing Check Valves for Water Service, 2.5" or greater:
1. Valves shall adhere to AWWA C508.

2. Valve shall be pressure rated to at least 150 psi.
3. Valves shall have resilient-to-metal seating.
4. Valves shall have assisted closing with lever and weight or spring. Valves shall have air-cushioned cylinders attached to levers to dampen closure.

C. Swing Check Valves for Chemical Service

1. Swing check valves shall have an external lever and weight, or spring assist, to aid in closing quickly and tightly.
2. Valves shall be capable of top entry to facilitate cleaning and repair without removal from the line.
3. Valve shall incorporate a single disc design suitable for horizontal or vertical applications.
4. Valve shall be pressure rated to at least 150 psi.
5. Valves shall be as manufactured by ASAHI/AMERICA, Spears Manufacturing Co., or approved equal.

D. Ball Check Valves for Chemical Service

1. Ball check valves shall have a ball which allows flow in one direction, but which seats against a seal to prevent flow in the other direction.
2. Valve shall be suitable for both horizontal and vertical installation.
3. Valve shall at least one integral union.
4. Valves shall be pressure rated to at least 100 psi.
5. Valves shall be as manufactured by ASAHI/AMERICA, Spears Manufacturing Co., or approved equal.

2.04 BALL VALVES

A. Ball Valves for Chemical Service

1. Ball valves shall have two way isolating capability and have elastomeric backing cushions behind the seats for low stem torque. Valve shall allow full port unobstructed flow when open.
2. Valve stems shall feature 2 stem O-rings.
3. Valves shall be operated with a lever. Valves shall have removable handles.
4. Valves shall be pressure rated to at least 150 psi.

5. Electrically actuated ball valves shall:
 - a. Adhere to the ball valve requirements in this section.
 - b. Have a time of closure/opening >5 seconds.
 - c. Mechanical and LED position indication.
 - d. Be Series 17 by Asahi/America or approved equal.
 6. Valves shall be as manufactured by ASAHI/AMERICA, Spears Manufacturing Co., or approved equal.
- B. Metal-Body for Water Service
1. Ball valves shall have two way sealed elastomeric isolating capability and allow full port unobstructed flow when open.
 2. Body to be made of lead-free bronze or lead-free brass.
 3. Valve shall be pressure rated to at least 250 psi.

2.05 DIAPHRAGM VALVES FOR SODIUM HYPOCHLORITE

- A. The valves shall come standard with position indicator, travel stop, and bonnet O-ring sealing arrangement. The valve shall be Weir type, square body/bonnet sealing design, and 1/4 turn bayonet style diaphragm/compressor connection. Valve shall be handwheel operated.
- B. Diaphragms shall be 3-layer style with PTFE wetted diaphragm, PVDF gas barrier, and EPDM Backing cushion. The PVDF Gas Barrier shall be between the EPDM and PTFE layers and prevent against gas migration outside of the valve.
- C. Valve shall be pressure rated to at least 150 psi.
- D. Valve shall be Type 14 by Asahi/America, Inc., or approved equal.

2.06 BUTTERFLY VALVES

- A. Metal Bodied for Water Service
 1. Butterfly valves shall be of the rubber-seated, tight-closing type conforming to the latest revision of AWWA C504.
 2. Butterfly valves shall be Class 150B, unless otherwise indicated on the Drawings, and of the short body design with mechanical joint or flanged ends, as shown on the Drawings.
 3. The exterior of the valve shall be shop coated with primer compatible with final field coat.

4. The interior shall be epoxy coated.
 5. All butterfly valves shall be the product of one manufacturer. Butterfly valves shall be as manufactured by DeZurik, Valmatic, Pratt, or equal.
- B. For Chemical Service
1. Valves shall be wafer type, lever operated.
 2. The valve shall have a liner that has full seat design fully molded around the body where as only the Disc and Seat are wetted parts and feature raised convex rings on the face and be utilized as the mating flange gaskets.
 3. Valve body shall have integral molded body stops and seat relief area to prevent over-tightening of the mating flanges.
 4. Valves shall accept flat faced flanges in accordance with ANSI B16.5 bolt pattern for 150 lb flanges.
 5. Valve stem shall be non-wetted, and have engagement over the full length of the spherically designed disc.
 6. Valve shall be pressure rated to at least 150 psi.
 7. Valve shall be as manufactured by ASAH/AMERICA, Spears Manufacturing Co., or approved equal.

2.06 AIR RELEASE VALVE

- A. Float operated to automatically release air from water piping system.
- B. ARV shall adhere to all requirements in AWWA C512.
- C. Body and Cover: Cast iron or ductile iron.
- D. Internal Parts and Float: Stainless steel.
- E. Valve shall be designed for at least 150 psig operating pressure.
- F. Acceptable Manufacturers: APCO – Valve and Primer Corp., Val-Matic Valve Co., or equal.

2.07 PRESSURE RELIEF, REDUCING AND REGULATING VALVES

- A. Pressure relief valves (not for chemical service) 1 inch and under shall have bronze bodies and above 1 inch shall have cast iron bodies, bronze fitted with grey iron diaphragm base and straight chamber and phosphorus bronze diaphragm. The ratio of the diaphragm area to the seat area shall be adequate to overcome sticking. The seat disc shall be of non-corrodible, non-sticking material capable of withstanding extreme temperatures. Valves shall permit dismantling for repairs and cleaning

without being removed from the line. Valves shall conform to the ASME Boiler Construction Code as approved by both the Underwriters Lab., and the National Board of Boiler Pressure Vessel Inspectors. All valves shall be designed for a minimum working pressure at least equal to the working pressure of the corresponding pipeline and shall have adjustment over a range of at least 20 percent above or below the required setting pressure of the installation.

- B. Pressure reducing and regulating valves (water service) 1/2-inch and under shall be bronze and above 1/2-inch shall have cast iron bodies bronze fitted. Valves shall be constructed with full openings and capable of supplying a full flow of water at reduced pressure. Valves shall be so constructed that repairs can be made without removing the valves from the line. The valves shall be equipped with a sedimentation chamber and stainless steel or bronze strainer. Pressure reducing and regulating valves shall be the back pressure sustaining type and shall operate over a range at differential pressures from 5 to 120 psi. Reducing and regulating valves shall meet or exceed the requirements of ASSE 1003 (ANSI A112.26.2) and shall be Model 616R, as manufactured by Fisher Controls, WATTS Series 25 AUB, GA, or equal.
- C. Overflow Relief Valve for Chemical Service
 - 1. Overflow relief valves shall be installed at the end of all chemical tank overflow pipes. Valve shall be same size as overflow pipe.
 - 2. Valve shall prevent chemical fumes from leaving overflow pipe using a spring-loaded plug which seals against a seat to produce a normally closed and sealed status.
 - 3. It shall "crack" open with a pressure of 0.5 psi, after which flow shall easily cross through the valve.
 - 4. The valves shall be "flange insert" type inserted between two mating flanges. Use flange gaskets which are suitable to the chemical. If the outlet mating flange does not already direct flow downward (instead of splattering sideways), add a 2" long nipple pipe to the end so that overflow liquid goes neatly downward.
 - 5. Valve shall be the Flange Insert Valve manufactured by Check All Valve Manufacturing Co., or approved equal.
- D. Pressure Relief Valves for Chemical Service
 - 1. Valves shall utilize an internal spring and a diaphragm to create the seal.
 - 2. Valve pressure setting shall be field adjustable without the need to remove the valve from service.
 - 3. Valve shall be by Griffco Valve, Inc. or equal.

2.08 BACKPRESSURE AND ANTI-SIPHON VALVE FOR CHEMICAL SERVICE

- A. One valve shall provide the dual function of supplying backpressure and preventing siphoning in the forward flow direction.
- B. Valves shall utilize an internal spring and a diaphragm to create the seal.
- C. Valve backpressure setting shall be field adjustable without the need to remove the valve from service.
- D. Valve shall be by Unibody Series manufactured by Griffco Valve, Inc. or equal.

2.09 INLINE Y-STRAINERS

- A. Water Service:
 - 1. Y-Strainers shall be Y-pattern cast iron body, flanged or screwed ends with stainless steel or Monel, 20 mesh strainers. Strainers shall be 200 psi, cold-water service strainers, as manufactured by WATTS, Crane Co., Zurn, or equal.
- B. Chemical Service:
 - 1. Strainers shall be Y-pattern and allow replacement of strainer screen without removing valve body from pipe line.
 - 2. Strainer body and screen shall be nonmetallic.
 - 3. Free area shall be at least 150% of pipe cross sectional area.
 - 4. Perforations in strainer shall be 1/32" diameter.
 - 5. Pressure rating shall be at least 150 psi.

2.10 HOSE BIBBS EXTERIOR

Cast brass with integral wall plate. Replaceable valve set, stainless steel shaft, nylon washer. 3/4" NPT outlet. Fixed operating wheel.

2.11 VALVE BOXES

- A. The Contractor shall furnish and install valve boxes as shown on the Drawings and specified herein.
- B. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve boxes rest shall be thoroughly compacted to prevent settlement. The boxes shall be fitted together securely and set so that the cover is flush with the finished grade of the adjacent surface. A concrete pad as detailed on the Drawings shall be provided around the valve box, sloped outwards.
- C. All valve boxes shall be 2-piece cast iron, sliding type, 5-1/4" shaft, with heavy duty traffic weight collar and the lid marked with the appropriate carrier product (i.e.:

WATER).

- D. East Jordan Iron Works or Bingham and Taylor.

2.12 CAM AND GROOVE (aka QUICK CONNECT) COUPLINGS FOR CHEMICAL SERVICE

- A. All C&G couplings for chemical service shall be made of polypropylene, even those for sodium hypochlorite.
- B. Gasket material shall be according to material requirements per chemical as specified elsewhere in this Section.

2.13 BACKFLOW PREVENTER

- A. Double check valve principal backflow preventers shall be of the size shown on the Drawings, and shall be WATTS 709, or equal.
- B. Reduced pressure zone backflow preventers shall be of the size shown on the Drawings, and shall be in accordance with AWWA Standards C510 and C511, with two (2) independent operating spring loaded check valves and one (1) spring loaded, diaphragm actuated, differential pressure relief valve installed between the check valves. Backflow preventers shall be bronze body construction, with EPT rubber discs and Buna-N and nylon diaphragm. Screws and springs shall be of stainless steel. End connections shall be flanged, unless otherwise specified or shown on the Drawings. The reduced pressure backflow preventers shall be as manufactured by Beeco Division, Hersey Products Inc., Aergap Model 6CM, WATTS 909, or equal.
- C. Backflow preventer installations shall include isolation valves and four test cocks, furnished as an assembly. For backflow preventers less than 2-1/2" the installation assembly shall also include a strainer. Isolation valves for backflow preventers shall be ball valves, except for sizes 2-1/2" and larger which shall be resilient seat gate valves. Test cocks shall be located as recommended by the manufacturer to facilitate functional testing of the assembly.

2.14 SERVICE SADDLES

- A. Service saddles shall be used with all chemical injection quills.
- B. Saddles shall adhere to AWWA C800 and be designed to be compatible with the pipe on which it is to be installed.
- C. Saddles shall be pressure rated to at least 100 psi.

2.15 UNIONS

- A. For ductile iron, carbon steel, and grey cast iron pipes assembled with threaded joints and malleable iron fittings, unions shall conform to ANSI B16.39.
- B. For copper piping, unions shall have ground joints and conform to ANSI B16.18.

2.16 FLEXIBLE EXPANSION JOINT FOR CHEMICAL SERVICE

- A. Flexible Expansion Joint bellows shall be made of PTFE for all chemicals, even for alum.
- B. Expansion joints shall have at least 3 convolutions.
- C. Expansion joints shall be rated to at least 100 psi and have limit rods installed.
- D. Expansion joint shall be Style 443-BD by Proco Products, Inc., or equal. Spring stiffness rates for all motion types shall not exceed 110% of those spring rates in this model.

2.17 FLEXIBLE PVC COUPLINGS FOR CHEMICAL SERVICE

- A. Couplings shall be made of single piece molded flexible PVC and secured with stainless steel band clamps.
- B. Couplings shall conform to ASTM D 5926, C 1173 and CSA B602.
- C. Couplings shall be manufactured by Fernco, Inc., or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install valves and accessories in accordance with the manufacturer's instructions.
- B. Inspect joint surfaces for structural soundness and thoroughly clean before installation.
- C. Pressure test all valves, while installed, along with the general piping system pressure tests.
- D. Test overflow relief valves to ensure that the cracking pressure is set properly. Do this by filling the vertically situated overflow pipe (before attaching it to tank) and determining what level of water is required to start opening the valve.
- E. Butterfly Valves

Each valve shall be performance and leak tested as specified in AWWA C504, revised as follows: In addition to the testing requirements of AWWA C504, each butterfly valve shall be thoroughly cleaned and opened and closed at least three (3) times prior to testing. Certified copies of the test results shall be submitted to the Engineer for approval prior to shipment of the valve.

3.02 ADJUSTMENT

Check and adjust valves and accessories for smooth operation.

END OF SECTION 15080

**SECTION 15094
PIPE SUPPORTS**

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes requirements for providing pipe hangers, brackets, supports, and spacing of expansion joints in piping systems as indicated in accordance with the Contract Documents. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.

1.02 JOB CONDITIONS

- A. In certain locations, pipe supports and anchors are shown on the drawings, but no attempt has been made to indicate every pipe support and anchor. It shall be the Contractor's responsibility to provide complete system of pipe supports and to anchor all piping in accordance with this section.
- B. Concrete and fabricated steel supports shall be as indicated on the drawings, as specified in other sections, or, in the absence of such requirements, as permitted by the Engineer.
- C. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.
- D. Pipe supports and expansion joints are not required in buried piping, but concrete blocking or other suitable anchorage shall be provided as indicated on the drawings or specified in other sections.

1.03 SUBMITTALS

Submit the following Contractor's drawings in accordance with [Section 01300](#).

- A. Layout drawings in conjunction with [Section 15060](#) showing the location of all pipe supports for pipes two-inches and larger.
- B. Catalog data for all pipe support components to be used.
- C. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Pipe supports shall comply with ANSI/MSS SP-58 and MSS SP-69 and Federal Specification WW-H-1713. Load carrying and coating tests will not be required.

- B. Pipe supports specified are identified by manufacturer's name and catalog number.
- C. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Straphangers will not be acceptable. Threaded rods shall have threading to permit the maximum adjustment available in the support item.
- D. All hangers and supports shall be capable of adjustment after installation. Types of hangers and supports shall be kept to a minimum.
- E. Pipe supports shall be furnished complete with all necessary inserts, bolts, nuts, rods, washers, and other accessories.
- F. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Those portions of pipe supports which contact other dissimilar metals shall be rubber or vinyl coated.
- G. Stainless steel supports fabricated by welding shall be AISI Type 304L or 316L material.
- H. All hardware, anchors, bolts, etc used for fastening or anchoring supports at the floor shall be 316 stainless steel.

2.02 DESCRIPTION

- A. Pipe support types and application shall comply with the following.

	Description or Size	MSS SP-69	Manufacturer and Model
A.	Hangers		
	2-1/2-inch and smaller pipe,		
	adjustable J	5	B-Line Fig. B3690, Grinnell Fig. 104, or equal.
	clevis	1	Grinnell Fig. 65, B-Line Fig. B3104, or equal.
	3-inch through 10-inch pipe		
	clevis	1	Grinnell Fig. 260, B-Line Fig. B3104, or equal.
	12 inch and larger pipe		

	Description or Size	MSS SP-69	Manufacturer and Model
	clevis	1	Grinnell Fig. 260, B-Line Fig. B3102, or equal
B.	Standard weight and extra strong steel pipe and stainless steel pipe (all sizes)		
	uninsulated, steel pipe clamp	4	Elcen "1", Fee & Mason "236", ITT Grinnell "212", or equal
C.	Concrete Rod Attachment Plate, 6-inch and smaller pipe	19	Grinnell Fig. 52, or equal.
D.	Turnbuckles, Steel	13	Elcen 81, Fee & Mason 2382, Grinnell Fig. 230, or equal
E.	Hangar Rods, Carbon Steel, threaded both ends, ½-inch minimum size	--	Elcen 72, Fee & Mason 267, Grinnell Fig. 140, or equal.
F.	Wall Supports and Frames, steel 12 inch and smaller pipe brackets	33,34	Grinnell Fig. 195 & 199; B-Line Fig. B3066 & B3067, or equal.
	prefabricated channels, galvanized	--	12 gauge, 1-5/8" x 1-5/8" with suitable brackets and pipe clamps.
	offset pipe clamp, 1-1/2-inch and smaller pipe, galvanized	--	1-1/4" x 3/16" steel, with 3/8" bolts.
	offset pipe clamp, 2-inch to 3-1/2-inch pipe, galvanized	--	1-1/4" x 3/16" steel, with 3/8" bolts.
G.	Pipe Riser Clamps		

	Description or Size	MSS SP-69	Manufacturer and Model
	cold piping system	–	Pipe Shields, Inc., "E1000", or equal
	copper tubing	–	CT-121 or CT-121C
	other piping systems	–	Grinnell "261", or equal
H.	Floor Supports, steel or cast iron, 6-inch and smaller pipe	38 (with base)	Grinnell Fig. 259; B-Line Fig. B-3095, or equal.
	8 inch through 30 inch pipe	38	B-Line "B3093", Grinnell "264", or equal

2.03 FRP STRUT SUPPORT SYSTEM

- A. Non-metallic support system shall be a heavy duty channel framing system. Channel frames shall be manufactured by the pultrusion process using corrosion grade polyester or vinylester resins. All fiberglass construction shall include suitable ultraviolet inhibitors for UV exposure and shall have a flame spread rating of 25 or less per ASTM E84. Piping accessories, pipe clamps, clevis hangers, support posts, support racks, fasteners, etc., shall be constructed of vinylester or polyurethane resin. Non-metallic support systems shall be standard make Aickinstrut by Aickinstrut, Inc., Unistrut Fiberglass by Unistrut, Inc., Enduro Fiberglass Systems, or equal. The Contractor shall submit data on the types and sizes of approval. Unless otherwise shown or specified the Contractor shall provide support spacing in conformance with the pipe and support system manufacturer's requirements.

PART 3 - EXECUTION

3.01 LOCATION AND SPACING

Piping shall be supported approximately 1-1/2 inches out from the face of walls and at least 3 inches below ceilings or beams. The maximum spacing for pipe supports and expansion joints shall be:

Type of Pipe	Pipe Support Maximum Spacing, Feet	Maximum Run without Expansion Joint, Loop or Bend, Feet (See Note 1)	Expansion Joint Maximum Spacing, Feet (See Note 2)	Type of Expansion Joint
<u>Ductile Iron</u>	15	80	80	Mechanical Couplings
<u>Steel:</u>				
1-1/4-inch and smaller	7	30	100	Note 3
1-1/2 to 4- inch	10	30	100	Note 3
<u>Copper:</u>				
1-inch and smaller	5	--	--	None required
Over 1-inch	7	50	100	Note 3
<u>PVC:</u>				
1/8- and 1/4-inch	Continuous Support	20	60	None required
1/2- to 2-inch	4	20	60	None required
Over 2-inch	6	20	60	None required
<u>Cast Iron Soil Pipe:</u>	10	-	-	None required

- Notes:
1. Unless otherwise permitted, an expansion joint shall be provided in each straight run of pipe having an overall length between loops or bends exceeding the maximum run specified herein.
 2. Unless otherwise permitted, the spacing between expansion joints in any straight pipe run shall not exceed the maximum spacing specified herein.
 3. Expansion joint fittings as specified in the miscellaneous piping section.
 4. At least two properly padded supports for each pipe section.
 5. At least one support for each pipe section.

3.02 INSTALLATION

- A. Concrete inserts or L-shaped anchor bolts shall be used to support piping from new cast-in-place concrete. Expansion anchors shall be used to fasten supports to masonry.
- B. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

- C. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows used as expansion joints.
- D. Provide dielectric isolation. Do not allow copper and other metals to make contact with each other.
- E. All piping and pipe supports located in sewage wetwells shall be stainless steel.
- F. All piping shall be supported and anchored so that there is no movement or visible sagging between supports.
- G. Hanger rods shall be straight and vertical. Chain, wire, strap, or perforated bar hangers shall not be used. Hangers shall not be suspended from other piping.
- H. Vertical Piping:
 - 1. Secure at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and its contents.
 - 2. Support vertical iron and steel pipe on maximum 5'-0" centers with steel pipe riser clamps.
 - 3. Support vertical copper tubing at no more than 10'-0" spacing, using plastic coated steel pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.
 - 4. Support vertical plastic pipe at 4'-0" centers, using plastic coated pipe riser clamps or pipe clamp hangers at end of runs and at intermediate points as installation dictates.
 - 5. Vertical piping shall be supported at each floor and between floors by stays or braces to prevent rattling and vibration.
- I. Horizontal Piping:
 - 1. Support at sufficiently close intervals to prevent sagging, thrust, and vibration.
 - 2. Install hangers or supports at ends of runs or branches and at each change of direction or alignment.
 - 3. Install steel clevis-type pipe hangers for horizontal iron and steel pipe on maximum 10'-0" centers.

4. Install steel clevis-type pipe hangers for copper tubing on 6'-0" centers for 1-1/4" size and smaller, and on 10'-0" centers for copper tubing larger than 1-1/4" size.
 5. Install plastic coated ring-type pipe hangers for horizontal plastic pipe on maximum 4'-0" centers, close to every joint, at ends of each branch, and at each change in direction of elevation; hangers shall not compress, distort, cut or abrade plastic piping and shall permit free movement of the pipe.
- J. The Contractor is responsible for properly bracing piping against lateral movement or sway. The Engineer shall review with the Contractor and approve method of bracing of piping at each location prior to Contractor proceeding with the installation of the bracing. Bracing shall be installed at all locations where sway is anticipated and as directed by the Engineer.
- K. Rubber hose and flexible tubing shall be provided with continuous angle or channel support.

END OF SECTION 15094

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**SECTION 15190
TESTING PIPING SYSTEMS**

PART I - GENERAL

1.01 DESCRIPTION

- A. The work of this section includes, but is not limited to
 - 1. Gravity Pipe Low-Pressure Air Testing
 - 2. Pressure Pipe Hydrostatic Testing
 - 3. Disinfection of Potable Water Piping
- B. Related Work Specified Elsewhere
 - 1. Section 02200 - Earthwork
 - 2. Section 15060 - Pipe and Pipe Fittings
 - 3. Section 15080 - Valves and Piping Specialties

1.02 GENERAL REQUIREMENTS

- A. The Engineer shall be notified in advance of all tests and all tests shall be conducted to his entire satisfaction. All tests shall be made prior to insulating piping.
- B. Repairs to the various systems shall be made with new materials. No caulking of threaded joints, cracks or holes will be acceptable. Where it becomes necessary to replace pieces of pipe, the replacement shall be the same material and thickness as the defective piece. Tests shall be repeated after defects disclosed thereby have been made good or the work replaced.
- C. All piping shall be adequately braced and supported during the tests so that no movement, displacement or damage shall result from the application of the test pressure. Relief devices in the various systems shall be capped or plugged during the tests.
- D. All equipment used in testing shall be subject to the approval of the Engineer, and shall be such as to properly develop, maintain and measure test procedures.

1.03 QUALITY ASSURANCE

- A. Reference Standards
 - 1. American Society for Testing and Materials (ASTM) C828 Low-Pressure Air Test of Vitrified Clay Pipelines

2. American National Standards Institute (ANSI); American Water Works Association (AWWA)
 - a. ANSI/AWWA C600 Section 4 - Hydrostatic Testing
 - b. ANSI/AWWA C651 Disinfecting Water Mains
- B. Test Acceptance
 1. No test will be accepted until leakage rate is below specified maximum limits.
 2. The Contractor shall determine and correct the cause of test failures and retest until successful test results are achieved.

1.04 SUBMITTALS

- A. Submit in accordance with [Section 01300](#).
- B. Submit the following prior to start of testing:
 1. Test Procedures
 2. List of Test Equipment
 3. Testing Sequence Schedule
 4. Certification of test pressure gauge calibration and accuracy.
 5. Certification of composition of chlorination products.

PART 2 - PRODUCTS

2.01 DISINFECTION PRODUCTS

- A. Liquid Chlorine: AWWA B301.
- B. Calcium Hypochlorite and Sodium Hypochlorite: AWWA B300.

2.02 AIR TESTING EQUIPMENT

- A. Air Compressor
- B. Air Supply Lines
- C. Test Connections
- D. Pressure Regulator

- E. Pressure Relief Valve
- F. Pressure Gauge Calibrated to 0.1 lb/sq. inch.

2.03 HYDROSTATIC TEST EQUIPMENT

- A. Hydro Pump
- B. Pressure Hose
- C. Test Connections
- D. Pressure Relief Valve
- E. Pressure Gauge Calibrated to 0.1 lb/sq. inch.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Backfill trenches in accordance with [Section 02200](#).
- B. Provide concrete reaction support blocking, cured a minimum of 7 days, or a minimum of 3 days if high early strength concrete is used, for the pipeline to be tested.
- C. Flush pipeline to remove debris; collect and dispose of flushing water and debris in a manner conforming to Regulatory Agency requirements.

3.02 AIR TESTING GRAVITY FLOW PIPELINES

- A. Test each section of gravity flow pipeline between structures; plug all pipeline outlets; brace plugs to offset thrust.
- B. Slowly introduce air to the plugged pipeline until internal air pressure is approximately 4.0 psig.
- C. If groundwater is present, determine its elevation above the springline of the pipe by means of a piezometric tube; for every foot of groundwater above the springline of the pipe, increase the starting test pressure reading by 0.43 psig; do not increase pressure above 10 psig.
- D. Allow air pressure to stabilize for at least five minutes; adjust pressure to 3.5 psig or to the increased test pressure as determined above if groundwater is present; start the test.
- E. Determine the test duration for a section with a single pipe size from the following table:

AIR TEST TABLE			
Minimum Test Time For Various Pipe Sizes			
Nominal Pipe Size	T (time) min/100 ft.	Nominal Pipe Size	T (time), min/100 ft.
3"	0.2	18"	2.4
4"	0.3	21"	3.0
6"	0.7	24"	3.6
8"	1.2	27"	4.2
10"	1.5	30"	4.8
12"	1.8	33"	5.4
15"	2.1	36"	6.0

- F. Record the drop in pressure during the test period; if the air pressure has dropped more than 1.0 psig during the test period, the line is presumed to have failed; if the 1.0 psig air pressure drop has not occurred during the test period, the test shall be discontinued and the line will be accepted.
- G. If the line fails, determine the source of the air leakage, make corrections and retest. After the leaks are repaired, retest the entire section.
- H. The Contractor has the option to test the section in incremental stages until the leaks are isolated.
- I. Testing Pipe Over 36" Diameter

Pipe larger than 36" diameter shall be subjected to a visual interior inspection.

3.03 HYDROSTATIC LEAKAGE TESTING PRESSURE FLOW PIPELINES

- A. Applicable to pressure flow yard piping.
- B. Hydrostatically test each section of pressure pipeline at the pressure designated on yard piping plan, based on the elevation of the lowest point in the pipeline corrected to the elevation of the test gauge, for a minimum period of one hour.
- C. Slowly fill the section with water, expelling air from pipeline at the high points; install corporation cocks at high points if necessary; after all air is expelled, close air vents and corporation cocks and raise the pressure to the specified test pressure.
- D. Observe joints, fittings and valves under test, remove and renew cracked pipe, joints, fittings, and valves showing visible leakage; retest.

- E. After visible deficiencies are corrected, continue testing at the same test pressure for an additional two hours to determine leakage rate.
- F. Maintain pressure within plus or minus 0.5 psig of test pressure.
- G. Leakage is defined as the quantity of water supplied to the pipeline necessary to maintain test pressure during the period of the test and shall not exceed that determined by the following formula:
$$L = \frac{ND (P)^{0.5}}{7,400}$$

Where: L is the allowable leakage in gallons per hour
N is the number of joints in the section tested
D is the nominal diameter of pipe in inches
P is the average test pressure in psig.
- H. If the test of the pipeline indicates leakage greater than that allowed, locate the source of the leakage, make connections and retest until leakage is within the allowable limits.
- I. Correct visible leaks regardless of the amount of leakage.

3.04 HYDROSTATIC TESTING PRESSURE PIPING SYSTEMS

- A. Applicable to chlorine solution piping system, potable water pressure system, chemical feed systems, and all process piping systems within the water treatment plant or raw water pumping station.
- B. Fill entire systems with water and vent air from the system at least 24 hours before the actual test pressure is applied.
- C. Apply the required test pressure when the water and average ambient temperatures are approximately equal and constant.
- D. Test piping at pressures listed on Yard Piping Plan; avoid excessive pressure on safety devices and mechanical seals.
- E. Maintain test pressure for a minimum of 2 hours without drop after the force pump has been disconnected.
- F. Visually inspect joints, fittings, and valves while pipe is under test pressure.
- G. Correct all visible leaks and retest as often as necessary until satisfactory results are achieved.

3.05 DISINFECTION OF POTABLE WATER PIPING

- A. Conduct disinfection of potable water system after completion of satisfactory pressure and leakage testing.

- B. Disinfect in accordance with recommended practice established by AWWA C651.
- C. Preliminary Flushing
 - 1. Flush the line at a rate of flow of 2.5 feet per second for a period of 15 minutes; refer to table at end of this Section for the rates of flow to produce a velocity of 2.5 fps.
 - 2. Provide and install one hydraulically propelled polyurethane "pig" in each line 4 inches or greater in diameter prior to flushing and flush the "pig" through the line; pig shall have the ability to negotiate fabricated mitered bends and short radius elbows and pass through tees, crosses and multi-dimensional sizes of pipe and valves.
 - 3. Dispose of flushing water in compliance with Federal, State and Local laws.
- D. Chlorine Form
 - 1. The chlorine form to be applied to the system shall be either liquid chlorine, calcium hypochlorite or sodium hypochlorite.
 - 2. The Engineer's written approval of the chlorine form to be used is required.
- E. Chlorine Application
 - 1. Introduce the chlorine to the system by use of the continuous feed method.
 - 2. Feed water and chlorine to the line at a constant rate so that chlorine concentration in the pipe is a minimum of 50 mg/L available chlorine.
 - 3. Continue chlorine applications until the entire system is filled with the chlorine solution.
 - 4. During the 24-hour treatment, operate all valves, stops, and hydrants in the section treated.
 - 5. At the completion of the 24-hour treatment, the water shall contain a minimum of 25 mg/L chlorine throughout the line.
 - 6. Repeat the disinfection process until the specified minimum available chlorine is present at the end of the treatment sequence.
- F. Final Flushing
 - 1. Flush the heavily chlorinated water from the system under treatment until the chlorine concentration in the water leaving the system is less than 1 mg/L.
 - 2. Comply with federal, state and local laws when discharging the flushed disinfecting chlorine solution.

G. Bacteriological Testing

1. After final flushing is completed and before the water main is placed in service, test the line for bacteriologic quality.
2. Collect a minimum of 2 samples in sterile bottles treated with sodium thiosulfate.
3. Provide bacteriological test reports to the Owner and the Engineer; failure to meet State Health Standard requirements will be cause for the Contractor to rechlorinate and retest the system, at no additional cost to the Owner.

TABLE				
Required Flow to Flush Pipelines *(a)				
Pipe Diameter (Inches)	Flow Required to Produce 25 fps Velocity in gpm	Size of Tap on Main (inches) *(b)	Hydrant Outlets	
			Number	Size (Inches)
4	100	15/16	1	2-1/2
6	220	1-3/8	1	2-1/2
8	390	1-7/8	1	2-1/2
10	610	2-5/16	1	2-1/2
12	880	2-13/16	1	2-1/2
*(a) With a 40 psi pressure in main, hydrant flowing to atmosphere, a 2-1/2" hydrant outlet will discharge approximately 1,000 gpm.				
*(b) Size of tap on main with no length of discharge piping.				

END OF SECTION 15190

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SECTION 15500
BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish all labor, equipment and material for the complete installation of the heating, ventilation, air conditioning, piping, etc. as indicated on the drawings and specified herein.
- B. Air conditioning systems shall be furnished and installed to operate as a system. The Contractor shall coordinate all requirements between manufacturers to insure unit responsibility and compatibility of the systems.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Division 5 - Metals
- B. Division 9 - Painting
- C. Division 16 - Electrical
- D. Division 17 - Control and Instrumentation Systems

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work or other mechanical and air conditioning work required, all in accordance with the requirements of Section 01300, Submittals.
- B. Data to be submitted shall include but not be limited to:
 - 1. Catalog data consisting of specifications, illustrations and a parts schedule that identifies the materials to be used for the various parts and accessories. The illustrations shall be in sufficient detail to serve as a guide for assembly and disassembly.
 - 2. Complete assembly, and installation drawings with clearly marked dimensions. This information shall be in sufficient detail to serve as a guide for assembly and disassembly and for ordering parts.
 - 3. Weight of all component parts and assembled weight.
 - 4. Electrical characteristics, wiring, diagrams, etc.
 - 5. Sample data sheet of equipment nameplate(s) including information contained thereon.

6. Insulation materials, coating, jackets, detail density, thermal conductivity and thickness of all insulation materials to be furnished.
 7. Details of special fasteners and accessories.
 8. Type of adhesives, binders, joint cement, mastics.
 9. Proposed insulation procedures and installation methods.
 10. Spare parts list
 11. Special tools list
- C. The Contractor shall obtain from the manufacturer and submit to the engineer copies of the results of all certified shop tests.
- D. The Contractor shall obtain from the manufacturer and submit to the engineer copies of certified letters of compliance in accordance with the Specifications.

1.04 OPERATION AND MAINTENANCE MANUALS

- A. The Contractor shall submit operation and maintenance manual in accordance with the procedures and requirements set forth in the General Conditions and Division 1.
- B. Operation and Maintenance Manuals shall be submitted for all equipment

1.05 MANUFACTURER'S INSTRUCTIONS

- A. Installation of all equipment shall be in accordance with manufacturer's data.
- B. All changes from the installation procedures in manufacturers' data shall be submitted for approval in accordance with the requirements for shop drawings.
- C. Keep all manufacturers' data provided in a secure manner at the job site at all times. Catalog and index this data for convenient reference.
- D. Manufacturers' data shall be available for the information of the Owner, Engineer, and the use of other trades.
- E. Turn over all data to the Owner through the Owner's representative at completion of the Work and final testing.
- F. Furnish Owner, indexed and bound in loose leaf binders, three (3) complete sets of Operating and Maintenance Instructions and pertinent manufacturers' literature and information on all of the apparatus and equipment under this Division of the Specifications.
- G. Submit all instruction books and manuals in accordance with Division 1.

1.06 CODES, PERMITS AND STANDARDS

- A. The Contractor shall obtain and pay for all permits and shall comply with all laws and codes that apply to the Work.
- B. The Contractor shall be responsible for all added expense due to his choice of equipment, materials or construction methods.
- C. All work and materials shall be in full accordance with the latest State rules and regulations or publications including those of the State Fire Marshall, the Uniform Plumbing Code, and all local codes. Nothing in the Plans and/or Specifications shall be construed to permit work not conforming to the above codes, rules and regulations.
- D. All equipment, materials and installations shall conform to the requirements of the most recent edition with latest revisions, supplements and amendments of the following, as applicable:

Air Conditioning and Refrigeration Institute (ARI)

Air Diffusion Council (ADC)

Air Moving and Conditioning Association (AMCA)

American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE)

American National Standards Institute (ANSI)

American Society for Testing and Materials (ASTM)

American Society of Mechanical Engineers (ASME)

Factory Mutual (FM)

National Electric Code (NEC)

NFPA 90A - Air Conditioning and Ventilation Systems

Occupational Safety and Health Standards (OSHA)

Sheet Metal & Air Conditioning Contractors National Association (SMACNA)

Standard Building Code - latest edition

Standard Mechanical Code - latest edition

Standard Plumbing Code - latest edition

State and local codes, ordinances and statutes

Underwriters Laboratories (UL)

Others as designated in the specifications.

1.07 QUALITY ASSURANCE

- A. All material and equipment shall be the latest design, new, undeteriorated, and the first quality standard product of manufacturers regularly engaged in the production of such material and equipment.
- B. When two or more units of the same class of material or equipment are required, they shall be products of a single manufacturer.
- C. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.
- D. Touch up and/or repaint to match original finishes all factory finished or painted equipment and materials, which are scratched or marred during shipment or installation.

1.08 IDENTIFICATION MARKERS

- A. Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color codes:
 - Yellow/Green: Supply air
 - Blue: Exhaust, outside, return and mixed air
 - Nomenclature: Include the following:
 - Direction of airflow.
 - Duct service (supply, return, exhaust, etc.)

1.09 GASKETS AND CONNECTORS

- A. Provide new gaskets wherever gasketed mating equipment items or pipe connections have been dismantled. Gaskets shall be in accordance with manufacturer's recommendations.
- B. Replace all assembly bolts, studs, nuts and fasteners of any kind which are bent, flattened, corroded or have their threads, heads or slots damaged.
- C. Furnish all bolts, studs, nuts and fasteners for make-up of all connections to equipment and replace any of these items damaged in storage, shipment or moving.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Each item of equipment shall be furnished and installed complete with all supports, mounting frames, duct work, piping, louvers, panels, grilles, electric drive units and controls, mechanical equipment, electrical work, insulation and appurtenances ready for operation.
- B. All equipment and appurtenances shall be anchored or connected to supporting members as specified or as indicated on the Plans.
- C. All mechanisms or parts shall be amply proportioned for the stresses, which may occur during operation, or for any other stresses, which may occur during fabrication and erection. Individual parts furnished which are alike in all units shall be alike in workmanship, design, and materials and shall be interchangeable. All equipment shall be of the manufacturer's top line, industrial-commercial grade.
- D. The Contractor shall ascertain that all chassis, shafts, and openings are correctly located, otherwise he shall cut all new openings required at his own expense. Cutting of new openings shall be coordinated with other trades. Proposed new cutting shall be submitted to the Engineer for review and acceptance prior to cutting.
- E. The Plans shall be taken as diagrammatic. The Contractor shall check the Structural Plans and sections for detail dimensions and clearances. Sizes of ducts and their locations are indicated, but not every offset, fitting, or structural obstruction is shown.
- F. Alignment of ducts may be varied where necessary to account for slight architectural changes or to avoid conflict with the Work of other trades without additional expense to the Owner.
- G. All supports required for the proper installation of the equipment, but not forming an integral part of the building structure, shall be provided, unless specifically noted otherwise. Equipment shall be supported on spring-type vibration isolators.

PART 3 - EXECUTION

END OF SECTION 15500

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**SECTION 15590
POWER VENTILATORS**

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. Provide exhaust fans which have been tested and rated in accordance with AMCA standard, and bear AMCA Certified Ratings Seal.
- B. Provide exhaust fans which are listed by UL and have UL label affixed, and which are designed, manufactured, and tested in accordance with UL 705 "Power Ventilators".
- C. Provide motors and electrical accessories complying with NEMA standards.
- D. Exhaust fans shall be standard prefabricated units of the type, size and arrangement indicated on the Drawings. All fans shall be rated and constructed in accordance with the Air Moving and Conditioning Association. Special construction materials, coatings and multi-speed fan motors shall be provided as indicated on the Drawings.
- E. The propellers shall be rigidly constructed, accurately balanced dynamically and statically and free from objectionable vibration or noise.
- F. Fans shall have no overloading characteristics for the horsepower indicated.
- G. V-belt drives shall be rated at least 50 percent greater than the rated motor horsepower, and shall have sheaves which can vary the fan speed by 10 percent above or below the rating point. The fan motor shall be mounted on an adjustable heavy steel mounting plate.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 15500 - Basic HVAC Requirements.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings on all equipment, accessories and appurtenances and all fabrication work required for all equipment specified in this section in accordance with Section 01300, Submittals. Additional required information shall include: the horsepower, voltage, and rotative speed of motors and the total weight of the equipment plus the approximate weight of the shipped materials. Shop drawings shall also include complete erection, installation, and adjustment instructions and recommendations.
- B. Operation and Maintenance Manuals

1. The Contractor shall submit complete operation and maintenance manuals in accordance with the procedures and requirements set forth in Section 01300, Submittals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. The materials covered by these specifications are intended to be standard equipment of proven reliability and as manufactured by reputable manufacturers having experience in the production of such equipment. The equipment furnished shall be designed, constructed, and installed in accordance with the best practices and methods and shall operate satisfactorily when installed as shown on the Contract Drawings and operated per manufacturer's recommendations.

2.02 GENERAL INFORMATION AND DESCRIPTION

- A. All parts of the equipment furnished shall be amply designed and constructed for the maximum stresses occurring during fabrication, erection and continuous operation. All materials shall be new and both workmanship and materials shall be of the very best quality, entirely suitable for the service to which the unit is to be subjected and shall conform to all applicable sections of these specifications. All parts of duplicate equipment shall be interchangeable without modification. Manufacturer's design shall accommodate all the requirements of these specifications.
- B. All anchor bolts, washers, clips, clamps and fasteners of any type shall be constructed of 316 stainless steel. All anchor bolts shall be a minimum of 1/2-inch diameter.

2.03 CENTRIFUGAL FANS

- A. Centrifugal fans shall be backwardly inclined, non-overloading blades of aluminum construction. Inlets shall be deep spun for nonturbulent entrance condition.
- B. Fans shall be V-belt or direct driven as indicated on the drawings or as contained herein.
- C. Motors on V-belt units shall be supported on the exterior of the fan casing with bearings encased within the fan tube. All models shall incorporate a 100 percent gasketed panel to permit access to interior direct drive motor. Motors shall be protected and cooled from outside the unit by forced ventilation.
- D. V-belt fans shall be supported by channel supports or brackets for ceiling suspension or wall mounting and provided with extended lubrication fittings and suitable vibration isolation provisions.
- E. Fans shall have internal terminal box mounted on the exterior for ready wiring.
- F. Centrifugal fans shall be as manufactured by Greenheck Fan Corp., Loren Cook Co., Penn Ventilator Co., or equal.

2.04 INLINE FANS

- A. Duct mounted supply, exhaust or return fans shall be of centrifugal belt driven in-line type. The fan housing shall be of the square design constructed of aluminum and shall include square duct mounting collars.
- B. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
- C. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- D. Motors shall be heavy-duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the airstream.
- E. Precision ground and polished stainless steel fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.
- F. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for system balancing.

2.05 ADDITIONAL REQUIREMENTS

The following additional requirements shall apply to all fans.

- A. Backdraft or motor-operated dampers shall be provided and installed in the openings as indicated on the Contract Drawings.
- B. All fans shall be provided with either integral or supplementary vibration or sound-absorbing mountings.
- C. Provide removable bird screen, 3/4 inch mesh, 12 gauge aluminum wire.
- D. Provide factory wired non-fusible type disconnect switch at motor in fan housing. Provide conduit chase within unit for electrical connection. The disconnect switch for outdoor fans shall be NEMA 4X stainless steel.
- E. Unless otherwise shown or specified all roof mounted exhaust fans shall be mounted on a prefabricated roof curb.

2.06 DAMPERS

- A. All exhaust fans shall include a damper. Dampers shall be coordinated to operate and interface with the fan being furnished. All dampers shall be low leakage type. Dampers shall be gravity or motor operated where indicated. Motor operators shall be rated for use on 120 VAC and shall be as manufactured by Honeywell, Barber-Coleman, or equal.
- B. Dampers shall have aluminum frames and blades with sealing edges and couplings at both ends with tie-rods. Dampers shall be predrilled to match the fan or louver. Damper finish colors shall be selected by the Engineer from the manufacturer's standard color chart.
- C. Dampers shall be sized to fit the specified openings.

PART 3 - EXECUTION

3.01 INSTALLATION OF POWER AND GRAVITY VENTILATORS

- A. Contractor shall install ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that ventilators serve their intended function.
- B. Contractor shall coordinate ventilator work with work of walls, and ceilings, as necessary for proper interfacing.
- C. Connect ducts to ventilators in accordance with manufacturer's installation instructions.

3.02 FIELD QUALITY CONTROL

- A. Testing: After installation of ventilators has been completed, test each ventilator to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.
- B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 15590

SECTION 15604
ELECTRIC SPACE HEATING UNITS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall furnish all labor, materials, tools and equipment necessary for furnishing, installing, connecting, testing and placing into satisfactory operation all electric space heating units as required for a complete electric installation as specified herein and indicated on the Drawings.
- B. The extent of the electric unit heaters work is indicated on the Drawings and further defined by the requirements of this Section. The Contractor shall reference the Electric Space Heating Units Schedule included herein or indicated on the Drawings for quantities, electrical ratings, ventilation ratings, and other unit specific information.

1.02 TESTING

- A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:
 - 1. Witnessed Shop Tests
None required.
 - 2. Certified Shop Tests
The electric space heating units shall be given routine factory tests in accordance with the requirements of the appropriate standards.
 - 3. Field Tests
- B. Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division 01, and Section 16000, Basic Electrical Requirements. The tests shall be made by the Contractor who shall also furnish the required testing equipment

1.03 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain form the equipment manufacturer and submit the following:
 - 1. Shop Drawings
 - 2. Spare Parts List

3. Special Tools List
 4. Reports of Certified Shop Tests
 5. Operation and Maintenance Manuals
- B. Each submittal shall be identified by the applicable Specification section.
- C. Shop Drawings
1. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.
 2. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.
 3. Shop drawings shall include but not be limited to:
 - a. Equipment specifications and product data sheets identifying all materials used and methods of fabrication.
 - b. Example equipment nameplate data sheet.
 - c. Complete wiring diagrams showing all devices requiring electrical connection, wire numbers, terminal block numbers and other pertinent wiring information.
- D. Operation and Maintenance Manuals
1. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.04 TOOLS, SUPPLIES AND SPARE PARTS

- A. The electric space heating units shall be furnished with all special tools necessary (one set per like piece of equipment) to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.
- B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.
- C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.
- D. Spare parts lists, included with the Shop Drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

- E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.05 IDENTIFICATION

- A. Each electric space heating unit shall be identified with the identification number on the Drawings (e.g. UH-1, UH-2, etc.). A nameplate shall be securely affixed in a conspicuous place on each unit. Nameplates shall be as specified in Section 16195, Electrical-Identification.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable firms regularly engaged in the manufacturing of electric space heating units, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 CORROSION RESISTANT UNIT HEATERS

- A. The cabinets shall be of 20 gauge Type 304 stainless steel. Individual adjustable louvers shall be furnished to provide desired control of discharge air. Adjustable louvers shall be finished with one coat of zinc chromatic primer and two coats of corrosion resistant paint for added moisture and corrosion resistance.

Unit heaters shall be furnished and installed with an electrical compartment sealed to allow the unit to be hosed down.

- B. The heating coils shall consist of monel fintube elements attached to junction box with leak-proof, threaded fittings for maximum corrosion resistance. A built-in, automatic reset, thermal overload protective device shall be provided for instantaneous operation of the power contactor holding coil in the event of an overload.
- C. Motors shall be totally enclosed continuous fan duty, sleeve bearing type equipped with built-in thermal overload protection. Each unit shall be equipped with a combination fan guard/motor support resiliently mounted at four (4) points to absorb any motor vibrations. The fan motor shall be wired within the unit heater to the electric heating coil power supply, thus eliminating the need for external motor starters or a separate fan motor circuit to the unit. Each unit heater shall be furnished with a NEMA 4X stainless steel disconnect switch.

- D. Fans shall be broad bladed aluminum directly connected to the fan motor, dynamically balanced and designed for the unit heater application. Fan shall be finished same as the adjustable discharge air louvers.
- E. On/off type operation shall be provided by interrupting the heater power supply with a contactor of suitable size as required by the equipment. The contactor holding coil shall in turn be operated by a thermostat. A pilot light shall be furnished and installed on the front of the unit to indicate energizing of the contactor coil and heating coil(s).
- F. The unit heater shall be supplied with a separate pilot duty wall mounted type thermostat unless otherwise indicated. The control circuit shall operate on 120 VAC, single phase, 60 hertz derived from a control power transformer furnished and installed with the unit.
- G. All heaters shall be UL listed and meet the requirements of the National Electrical Code. Electrical components for unit heaters shall be listed and labeled by U.L.

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall handle the unit heaters and components carefully to prevent damage, breaking, denting and scoring. Contractor shall not install damaged electric unit heaters or components.
- B. The Contractor shall store the unit heaters and components in a clean dry place, which will adequately protect the units from weather, dirt, fumes, water, construction debris, and physical damage.
- C. The Contractor shall comply with the manufacturer's rigging and installation instructions for unloading unit heaters, and moving them to final location.

3.02 INSTALLATION

- A. The Contractor shall install unit heaters as indicated on the Drawings, in accordance with the manufacturer's installation instructions, and shall verify that the manufacturer's nameplate data corresponds with the unit designation.
- B. The Contractor shall hang/support the units from substantial structural components of the building (e.g. walls, floors, columns, beams, etc.). Units shall not be hung from piping. The Contractor shall mount the unit heaters as high as possible to maintain the greatest headroom possible unless otherwise indicated. The unit shall be supported with rod-type hangers anchored to building structural components and shall be protected with a protective cover during the balance of construction.

3.03 ADJUSTING AND CLEANING

- A. After installation is completed, the Contractor shall clean all exposed unit surfaces, vacuum the heating coils and vacuum the inside of the cabinets.

END OF SECTION 15604

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**SECTION 15605
LOUVERS AND DAMPERS**

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish all labor, materials, equipment, and appliances required for the complete execution of additions, modifications, alterations, to existing buildings and new construction work as shown on the Drawings and specified under the several sections of the Specifications.
- B. Principal items of work include:
 - 1. Combination louver damper.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 01300 – Submittals

1.03 REFERENCE CODES, SPECIFICATIONS AND STANDARDS

- A. Without limiting the generality of these Specifications, work shall conform to the applicable requirements of the following documents. All referenced Specifications, codes, and standards refer to the most current issue available at the time of the Bid.
 - 1. All work shall comply with the Standard Building Code and the requirements of all other authorities having jurisdiction.
 - 2. All units shall conform to AA-Aluminum Standards and Data, latest edition.
 - 3. Louvers shall bear the AMCA Seal with ratings in accordance with AMCA Standard 500 which applies to air performance ratings and water penetration ratings.
 - 4. All louvers, fasteners and supports shall be designed to meet a wind loading in accordance with the local building codes, but shall not be less than 25 pounds per square foot.

1.04 SUBMITTALS

- A. In accordance with the procedures and requirements set forth in the General Conditions, City Standard Specification 4-1, and Division I, the Contractor shall submit the following:
 - 1. Samples
 - 2. Shop Drawings

- B. Each submittal shall be identified by the Specification Section Number.
- C. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed materials compliance with the Contract Documents.
- D. Partial, incomplete or illegible submissions will be returned to the Contractor without review for resubmission.
- E. Samples shall include:
 - 1. Color and finish samples for each finish type required.
- F. Shop Drawings shall include but not be limited to:
 - 1. Complete detail drawings showing materials, methods of fabrication and clearly indicating all dimensions.
 - 2. Detailed installation drawings showing all methods of attachment.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Brace and support units to prevent deformation during delivery.
- B. Factory wrap units with approved materials to protect finish during delivery and storage.
- C. Handle units with care to prevent bending or scratching.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Specifications, provide products manufactured by the following:
 - 1. Construction Specialties, Inc.
 - 2. Ruskin, Philips Industries, Inc.
 - 3. Airolite Company, Marietta, Ohio

2.02 FABRICATION

- A. Extruded aluminum 6063-T52 alloy, extruded within commercial tolerances and free of defects, minimum .081 inches thick with reinforcing bosses. All corners of frames shall be reinforced and welded.

- B. Hardware and fasteners shall be of Type 316 stainless steel placed through nylon bushings.
- C. The louvers shall be architectural style, combination drainable type.
- D. The stationary blades and adjustable blades shall be contained within a single 6 inch louver frame. Adjustable section shall include low leakage blades and jamb seals.
- E. Frames shall be 0.125 inches thick, stationary front section 0.081 inch wall thickness. Adjustable rear section 0.125 inch wall thickness through 48 inch blade width, 0.140 inch wall thickness 48 inch to 60 inch blade width.
- F. Louver and damper assemblies which are to be placed in openings exceeding 5 feet in width shall have slidable interlocked heavy gauge extruded aluminum mullions at mid span of integral tongue and groove construction.
- G. Electrically operated damper shall be standard with the approved manufacturer. Electrical characteristics to be coordinated with the Electrical Sections of Division 16 and the Engineer.
- H. Coordinate louver sizes and free area requirements with the HVAC work.
- I. Provide blanked off sections as required.
- J. Bird screens shall be 1/2-inch square FRP or aluminum mesh P.V.C. coated, placed in removable .081-inch thick folded aluminum frames standard with the manufacturer.

2.03 FINISH

- A. Extruded aluminum louvers and damper frames and blades to receive finish in accordance with the Aluminum Designation AA-M12-C22-A44, anodic coating Architectural Class I.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Anchor louver frames using stainless steel bolts into holes drilled and tapped in channel or angle subframes and suspended lintels, or with strap anchors to masonry in accordance with the manufacturer's approved directions.
- B. Isolate aluminum from contact with masonry or dissimilar metals with heavy coat of bituminous paint or neoprene gaskets.
- C. Mount bird screens on inside face with clips, machine screwed into frames.
- D. All frames shall be installed with aluminum (or compatible) screws, bolts, anchors, etc., in such a manner that the frames are removable.

3.02 CUTTING AND FITTING

- A. Do all cutting and fitting required for the installation in a neat manner.

3.03 CLEANING

- A. Upon completion remove any and all protective coatings, clean off all parts of the work and leave entire installation in orderly condition.

END OF SECTION 15605