

DIVISION 15 MECHANICAL

1 00L29

2 **SECTION 15060**
3 **PIPE AND PIPE FITTINGS: BASIC REQUIREMENTS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Process piping systems.
- 8 2. Utility piping systems.
- 9 B. Related Sections include but are not necessarily limited to:
- 10 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 1 - General Requirements.
- 12 3. Section 01733 - Disinfection of Facilities.
- 13 4. Section 02221 - Trenching, Backfilling, and Compacting for Utilities.
- 14 5. Section 09905 - Painting and Protective Coatings.
- 15 6. Section 10400 - Identification, Stenciling, and Tagging Systems.
- 16 7. Section 11005 - Equipment: Basic Requirements.
- 17 8. Section 15090 - Pipe Support Systems.
- 18 9. Section 15100 - Valves: Basic Requirements.
- 19 10. Section 15183 - Pipe, Duct and Equipment Insulation.

20 **1.2 QUALITY ASSURANCE**

- 21 A. Referenced Standards:
- 22 1. American Association of State Highway and Transportation Officials (AASHTO):
- 23 a. M36, Corrugated Steel Culverts and Underdrains.
- 24 b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe
- 25 and Pipe Arches.
- 26 c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
- 27 d. M278, Standard Specification for Class PS 46 Polyvinyl Chloride (PVC) Pipe.
- 28 e. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.
- 29 2. American National Standards Institute (ANSI):
- 30 a. B16.3, Malleable Iron Threaded Fittings.
- 31 b. B16.5, Pipe Flanges and Flanged Fittings.
- 32 c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
- 33 d. B31.1, Power Piping.
- 34 e. B36.19, Stainless Steel Pipe.
- 35 f. B40.1, Gauges - Pressure Indicating Dial Type - Elastic Element.
- 36 3. American National Standards Institute (ANSI)/American Water Works Association
- 37 (AWWA):
- 38 a. ANSI/AWWA C110/A21.10, Ductile Iron and Gray Iron Fittings, 3 IN through 48 IN
- 39 for Water and Other Liquids.
- 40 b. ANSI/AWWA C115/A21.15, Flanged Ductile Iron Pipe with Threaded Flanges.
- 41 c. ANSI/AWWA C151, Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sand-
- 42 Lined Molds for Water or Other Liquids.
- 43 d. ANSI/AWWA C153/A21.53, Ductile-Iron Compact Fittings, 3 IN Through 16 IN, for
- 44 Water and Other Liquids.
- 45 4. American Society for Testing and Materials (ASTM):
- 46 a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated
- 47 Welded and Seamless.
- 48 b. A74, Cast-Iron Soil Pipe and Fittings.

- c. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - d. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - e. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - f. A312, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
 - g. A536, Standard Specification for Ductile Iron Castings.
 - h. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
 - i. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
 - j. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.
 - k. C443, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 - l. C564, Rubber Gaskets for Cast-Iron Soil Pipe and Fittings.
 - m. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - n. D2466, Socket Type (PVC) Plastic Pipe Fittings, Schedule 40.
 - o. D2467, Socket Type (PVC) Plastic Pipe Fittings, Schedule 80.
 - p. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals.
 - q. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - r. F438, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
 - s. F439, Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
 - t. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
- 5. American Water Works Association (AWWA):
 - a. B300, Standard for Hypochlorites.
 - b. C111, Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
 - c. C200, Steel Water Pipe 6 IN and Larger.
 - d. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
 - e. C208, Dimensions for Fabricated Steel Water Pipe Fittings.
 - f. C606, Grooved and Shouldered Joints.
 - g. C651, Standard for Disinfecting Water Mains.
 - 6. National Fire Protection Association (NFPA):
 - a. 54, National Fuel Gas Code.
 - b. 69, Standard on Explosion Prevention Systems.
 - 7. Underwriters Laboratory, Inc. (UL).

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 SYSTEM DESCRIPTION

- A. Piping Systems Organization and Definition:
 - 1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
 - 2. Table A below defines each service classification, its symbol, and the designated system classification number of each service.
 - a. Refer to Drawings for specific piping services.

TABLE A. PIPING SERVICES		
SYMBOL	SERVICE	SYSTEM
BP	Backpulse	2
BWR	Backwash Recycle/Reject	2
CCW	Cleaning Chemical Waste	2
CHV	Chemical Vent	27
CLS	Chlorine Solution	7
CAS	Citric Acid Solution	7
CA	Control Air	13
D	Drain Line	27
FES	Ferric Sulfate Solution	7
FW	Feed Water	2
FN	Finished Water	2
NG	Natural Gas	5
NPW	Non-Potable Water	10
PER	Permeate Water	2
PWC	Potable Water Cold	10
PWH	Potable Water Hot	10
PA	Process Air	13
RW	Raw Water	2
SAM	Sample	27
SMD	Sample Drain	27
SVW	Service Water	10
SBS	Sodium Bisulfite Solution	7
SHS	Sodium Hydroxide Solution	7
VT	Vent	27
VTR	Vent Through Roof	27

2
3 3. See PIPING SPECIFICATION SCHEDULES in PART 3.

4 **1.4 SUBMITTALS**

5 A. See Section 01340 for administration of submittals.

6 B. Shop Drawings:

7 1. Fabrication and/or layout drawings:

- 8 a. Exterior yard piping drawings (minimum scale 1 IN equals 10 FT) with information
9 including:
- 10 1) Dimensions of piping lengths.
 - 11 2) Invert or centerline elevations of piping crossings.
 - 12 3) Acknowledgement of bury depth requirements.
 - 13 4) Details of fittings, tapping locations, restrained mechanical joint segments,
14 harnessed joint segments, hydrants, and related appurtenances.
 - 15 5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument
16 tag numbers, pipe and line numbers.
 - 17 6) Line slopes and vents.
- 18 b. Interior piping drawings (minimum scale 1/8 IN equals 1 FT) with information
19 including:
- 20 1) Dimensions of piping from column lines or wall surfaces.
 - 21 2) Centerline dimensions of piping.
 - 22 3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or
23 other potential interferences requiring coordination.
 - 24 4) Location and type of pipe supports and anchors.
 - 25 5) Locations of valves and valve actuator type.

- 1 6) Details of fittings, tapping locations, equipment connections, flexible expansion
- 2 joints, connections to equipment, and related appurtenances.
- 3 7) Acknowledgement of valve, equipment and instrument tag numbers.
- 4 8) Provisions for expansion and contraction.
- 5 9) Line slopes and air release vents.
- 6 c. Schedule of interconnections to existing piping and method of connection.
- 7 d. Cleaning procedure and schedule.
- 8 2. Product technical data including:
- 9 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 10 b. Copies of manufacturer's written directions regarding material handling, delivery,
- 11 storage and installation.
- 12 c. Separate schedule sheet for each piping system scheduled in this Section showing
- 13 compliance of all system components. Attach technical product data on gaskets, pipe,
- 14 fittings, and other components.
- 15 3. A testing schedule, including proposed plans for water conveyance, control, and disposal
- 16 shall be submitted in writing for approval a minimum of 10 work days before testing is to
- 17 start.
- 18 a. See Section 01650 for additional requirements.
- 19 C. Miscellaneous Submittals:
- 20 1. Qualifications of lab performing disinfection analysis on water systems.
- 21 2. Test reports:
- 22 a. Copies of pressure test results on all piping systems.
- 23 b. Reports defining results of dielectric testing and corrective action taken.
- 24 c. Disinfection test report.
- 25 d. Notification of time and date of piping pressure tests.
- 26 D. Operation and Maintenance Manuals:
- 27 1. See Section 01340.

28 **1.5 DELIVERY, STORAGE, AND HANDLING**

- 29 A. Protect pipe coating during handling using methods recommended by manufacturer. Use of bare
- 30 cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.
- 31 B. Prevent damage to pipe during transit. Repair abrasions, scars, and blemishes. If repair of
- 32 satisfactory quality cannot be achieved, replace damaged material immediately.

33 **PART 2 - PRODUCTS**

34 **2.1 ACCEPTABLE MANUFACTURERS**

- 35 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 36 acceptable:
- 37 1. Insulating unions:
- 38 a. "Dielectric" by Epco.
- 39 2. Dirt strainers (Y type):
- 40 a. Mueller (#351).
- 41 b. Sarco.
- 42 c. Armstrong.
- 43 3. Chemical strainers (Y type):
- 44 a. Chemtrol.
- 45 b. Asahi.
- 46 4. Dry disconnect couplings:
- 47 a. Kamlock.
- 48 5. Pipe saddles (for gage installation):
- 49 a. Dresser Style 91 (steel and ductile iron systems).

- 1 b. Dresser Style 194 (non-metallic systems).
- 2 B. Submit requests for substitution in accordance with Specification Section 01640.

3 **2.2 PIPING SPECIFICATION SCHEDULES**

- 4 A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping
- 5 specification schedules located at the end of PART 3 of this Section.

6 **2.3 COMPONENTS AND ACCESSORIES**

- 7 A. Insulating Components:
 - 8 1. Dielectric flange kits:
 - 9 a. See Section 13110.
 - 10 2. Dielectric unions:
 - 11 a. Screwed end connections.
 - 12 b. Rated at 175 psi, 210 DegF.
 - 13 c. Provide dielectric gaskets suitable for continuous operation at union rated temperature
 - 14 and pressure.
- 15 B. Dirt Strainers:
 - 16 1. Y-type.
 - 17 2. Composition bronze or compatible with piping system in which strainer is placed.
 - 18 3. Rated for test pressure and temperature of system in which they are installed.
 - 19 4. 20 mesh monel screen.
 - 20 5. Threaded bronze plug in the blowoff outlet or compatible with piping system in which
 - 21 strainer is placed.
 - 22 6. Threaded NPT end connections.
- 23 C. Strainers for Chemical Applications:
 - 24 1. Y-type.
 - 25 2. Strainers of same material, test pressure, and temperature rating as system in which strainer
 - 26 is placed.
- 27 D. Reducers:
 - 28 1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment
 - 29 connections. Connection size requirements may change from those shown on Drawings
 - 30 depending on equipment furnished.
- 31 E. Split Sleeve Coupling
 - 32 1. Flexible mechanical pipe couplings and flanged coupling adapters can also be Victaulic
 - 33 Depend-O-Lok or approved equal split-sleeve type with single or double arch cross section
 - 34 constructed of ASTM A-36 carbon steel or appropriate stainless steel.
 - 35 2. The coupling closes around the pipe ends using elastomeric or fluid compatible gaskets
 - 36 compressed bench arch cross sections and elastomeric sealing plate to seal the joint for the
 - 37 required maximum working or test pressure. IF thrust restraint is required, the manufacturer
 - 38 will provide end rings that are to be welded to the pipe per the manufacturer's requirements
 - 39 in lieu of other types of AWWA M-11 restraint systems.
 - 40 3. The coupling shall permit a degree of angular pipe deflection, flexibility, contraction, and
 - 41 expansion as listed by the manufacturer's latest published literature.
 - 42 4. Material: Carbon steel for carbon steel and exposed ductile iron piping systems or stainless
 - 43 steel for stainless steel and buried or submerged piping systems.
 - 44 5. Gasket: Suitable for fluid contained in piping or air service, whichever is more restrictive.
 - 45 6. Bolts and nuts: Alloy steel, corrosion resistant, prime coated. Buried couplings shall have
 - 46 Type 316 stainless steel bolts and nuts.
 - 47 7. Product and manufacturer: Provide one of the following:
 - 48 a. Victaulic Depend-O-Lok ExE (unrestrained).
 - 49 b. Victaulic Depend-O-Lok FxF (restrained).
 - 50 c. Or approved equal.

- 1 F. Protective Coating and Lining:
 2 1. Include pipe, fittings, and appurtenances where coatings, linings, paint, tests and other items
 3 are specified.
 4 2. Field paint pipe in accordance with Section 09905.
- 5 G. Underground Warning Tape:
 6 1. See Section 10400.
- 7 H. Pressure Gages:
 8 1. See Sections 11005.
- 9 I. Dry Disconnect Couplings:
 10 1. Adapters:
 11 a. Male adapters: Size shown on Drawings.
 12 b. Adapters:
 13 1) Female NPT end connection for sludge and flush applications.
 14 2) Male NPT end connection for chemical applications.
 15 c. Construct adapters for sludge applications from cast iron or steel.
 16 d. Construct adapters for chemical and PVC system applications 3 IN and below from
 17 polypropylene. Above 3 IN size, provide stainless steel units.
 18 2. Couplers:
 19 a. Built-in valve and spring loaded poppet which close automatically when disconnected.
 20 b. Designed to remain with only one arm locked in closed position.
 21 c. Construct couplers for sludge applications fabricated from material utilized for
 22 adapters.
 23 d. Construct couplers for chemical and PVC system applications 3 IN and less from
 24 polypropylene with stainless steel arms and pins. Above 3 IN, provide stainless steel
 25 units.
 26 e. Gasket: Compatible with conveyed liquid.
 27 3. Dust caps: For all adapters.
- 28 J. Heat shrinkable field joint protective sleeve:
 29 1. Cross-linked polyolefin wrap or sleeve with a mastic sealant.
 30 2. Comply with AWWA C216 and manufacturer's recommendations.
 31 3. Minimum thickness: 60 mils.
 32 4. Overlap polyurethane coating on pipe by a minimum of 3 IN on each side of joint. Width of
 33 heat shrink sleeve shall take into consideration shrinkage of sleeve due to installation and
 34 joint profile. Overlapping of two or more heat shrink sleeves to achieve the necessary width
 35 will not be permitted.
 36 5. Acceptable manufacturers:
 37 a. Canusa.
 38 b. Raychem.
 39 c. Or approved equal.
- 40 K. Valves:
 41 1. See Section 15100.

42 **PART 3 - EXECUTION**

43 **3.1 EXTERIOR BURIED PIPING INSTALLATION**

- 44 A. Unless otherwise shown on the Drawings, provide a minimum of 4 FT and maximum of 8 FT
 45 earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or
 46 solutions subject to freezing.

- 1 B. Unless otherwise shown on the Drawings, where a potable waterline (FN, SVW) crosses a non-
2 potable pressure rated line, one segment of the waterline pipe shall be centered over the non-
3 potable line such that the joints of the waterline pipe are equidistant horizontally from the
4 centerline of the non-potable line. The potable waterline shall be at least six inches above the
5 non-potable line. Whenever possible, the crossing should be centered between the joints of the
6 non-potable line. The non-potable line shall be embedded in cement stabilized embedment as
7 specified in Section 02221 for the total length of one pipe segment plus 12 inches beyond the
8 joint on each end.
- 9 C. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals
10 specified in Section 01800 and as shown on Drawings.
- 11 D. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT
12 of point where pipe enters or leaves structure. Install second joint not more than 6 FT nor less
13 than 4 FT from first joint for piping less than 6 IN.
- 14 E. Install expansion devices as necessary to allow expansion and contraction movement.
- 15 F. Laying Pipe In Trench:
16 1. Excavate and backfill trench in accordance with Section 02221.
17 2. Clean each pipe length thoroughly and inspect for compliance to Specifications.
18 3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
19 4. Install gasket or joint material according to manufacturer's directions after joints have been
20 thoroughly cleaned and examined.
21 5. Except for first two joints, before making final connections of joints, install two full sections
22 of pipe with earth tamped along side of pipe or final with bedding material placed.
23 6. Lay pipe in only suitable weather with good trench conditions. Never lay pipe in water
24 except where approved by Engineer.
25 7. Seal open end of line with watertight plug if pipe laying stopped.
26 8. Remove water in trench before removal of plug.
- 27 G. Lining Up Push-On Joint Piping:
28 1. Lay piping on route lines shown on Drawings.
29 2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
30 3. Observe maximum deflection values stated in manufacturer's written literature.
31 4. Provide special bends when specified or where required alignment exceeds allowable
32 deflections stipulated.
33 5. Install shorter lengths of pipe in such length and number that angular deflection of any joint,
34 as represented by specified maximum deflection, is not exceeded.
- 35 H. Anchorage:
36 1. All buried piping shall have fully restrained joints along its entire length.
37 2. Only where specifically approved by Engineer:
38 a. Provide anchors, joint harnesses, or other acceptable means for preventing movement
39 of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
- 40 I. Install underground hazard warning tape per Section 10400.
- 41 J. Install insulating components where dissimilar metals are joined together, at connections to
42 foreign pipelines, and at connections to structures.

43 3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

- 44 A. Install piping in vertical and horizontal alignment as shown on Drawings.
- 45 B. Alignment of piping smaller than 4 IN may not be shown or may be shown schematically.
46 However, install according to Drawing intent and with clearance and allowance for:
47 1. Expansion and contraction.
48 2. Operation and access to equipment, doors, windows, hoists, moving equipment.
49 3. Headroom and walking space for working areas and aisles.
50 4. System drainage and air removal.

- 1 C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified
2 in Section 01800 and as shown on the Drawings.
- 3 D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.
- 4 E. Pipe Support:
5 1. Use methods of piping support as shown on Drawings and as required in Section 15090.
6 2. Where pipes run parallel and at same elevation or grade, they may be grouped and
7 supported from common trapeze-type hanger, provided hanger rods are increased in size as
8 specified for total supported weight. The pipe in the group requiring the least maximum
9 distance between supports shall set the distance between trapeze hangers.
10 3. Size pipe supports with consideration to specific gravity of liquid being piped.
- 11 F. Locate and size sleeves and castings required for piping system. Arrange for chases, recesses,
12 inserts or anchors at proper elevation and location.
- 13 G. Use reducing fittings throughout piping systems. Bushings will not be allowed unless
14 specifically approved.
- 15 H. Equipment Drainage and Miscellaneous Piping:
16 1. Provide drip pans and piping at equipment where condensation may occur.
17 2. Hard pipe stuffing box leakage to nearest floor drain.
18 3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
19 a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and
20 over full length of electrical equipment.
21 b. Hard pipe drainage to nearest floor drain.
22 4. Collect system condensate at drip pockets, traps and blowoff valves.
23 5. Provide drainage for process piping at locations shown on Drawings in accordance with
24 Drawing details.
25 6. For applications defined above and for other miscellaneous piping which is not addressed by
26 a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.
27 Size to handle application with 3/4 IN being minimum size provided.
- 28 I. Unions:
29 1. Install in position which will permit valve or equipment to be removed without dismantling
30 adjacent piping.
31 2. Mechanical type couplings may serve as unions.
32 3. Additional flange unions or flange coupling adapters are required at flanged connections.
- 33 J. Install expansion devices as necessary to allow expansion/contraction movement.
- 34 K. Provide full face gaskets on all systems.
- 35 L. Anchorage and Blocking:
36 1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to
37 prevent separation of joints and transmission of stress into equipment or structural
38 components not designed to resist those stresses.
- 39 M. Equipment Pipe Connections:
40 1. Equipment - General:
41 a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of
42 pipe or fitting which would prevent uniform gasket pressure at connection or would
43 cause unnecessary stresses to be transmitted to equipment flanges.
44 b. Where push-on joints are used in conjunction with flanged joints, final positioning of
45 push-on joints shall not be made until flange joints have been tightened without strain.
46 c. Tighten flange bolts at uniform rate which will result in uniform gasket compression
47 over entire area of joint. Provide tightening torque in accordance with manufacturer's
48 recommendations.
49 d. Support and match flange faces to uniform contact over their entire face area prior to
50 installation of any bolt between the piping flange and equipment connecting flange.

- 1 e. Permit piping connected to equipment to freely move in directions parallel to
- 2 longitudinal centerline when and while bolts in connection flange are tightened.
- 3 f. Align, level, and wedge equipment into place during fitting and alignment of
- 4 connecting piping.
- 5 g. Grout equipment into place prior to final bolting of piping but not before initial fitting
- 6 and alignment.
- 7 h. To provide maximum flexibility and ease of alignment, assemble connecting piping
- 8 with gaskets in place and minimum of four bolts per joint installed and tightened. Test
- 9 alignment by loosening flange bolts to see if there is any change in relationship of
- 10 piping flange with equipment connecting flange. Realign as necessary, install flange
- 11 bolts and make equipment connection.
- 12 i. Provide utility connections to equipment shown on Drawings, scheduled or specified.
- 13 2. Plumbing and HVAC equipment:
- 14 a. See Sections 15440 and 15605.
- 15 N. Provide insulating components where dissimilar metals are joined together.
- 16 O. Instrument Connections:
- 17 1. See drawing details.

18 3.3 CONNECTIONS WITH EXISTING PIPING

- 19 A. Where connection between new work and existing work is made, use suitable and proper fittings
- 20 to suit conditions encountered.
- 21 B. Perform connections with existing piping at time and under conditions which will least interfere
- 22 with service to customers affected by such operation.
- 23 C. Undertake connections in fashion which will disturb system as little as possible.
- 24 D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed
- 25 without damage to adjacent property.
- 26 E. Where connections to existing systems necessitate employment of past installation methods not
- 27 currently part of trade practice, utilize necessary special piping components.
- 28 F. Where connection involves potable water systems, provide disinfection methods as prescribed in
- 29 these Specifications.
- 30 G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made
- 31 and tested.

32 3.4 ACCESS PROVISIONS

- 33 A. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping
- 34 and piping appurtenances requiring service.
- 35 B. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 IN size.
- 36 C. Fabricate door and frame of minimum 14 GA, stretcher leveled stock, cadmium plated or
- 37 galvanized after fabrication and fitted with screw driver lock of cam type.
- 38 D. Provide with key locks, keyed alike, in public use areas.
- 39 E. Furnish panels with prime coat of paint.
- 40 F. Style and type as required for material in which door installed.
- 41 G. Where door is installed in fire-rated construction, provide door bearing UL label required for
- 42 condition.

43 3.5 PRESSURE GAGES

- 44 A. Provide at locations shown on the Drawings and specified.

1 B. See Section 11005.

2 **3.6 FIELD QUALITY CONTROL**

3 A. Pipe Testing - General:

- 4 1. Test piping systems as follows:
- 5 a. Test exposed, non-insulated piping systems upon completion of system.
- 6 b. Test exposed, insulated piping systems upon completion of system but prior to
- 7 application of insulation.
- 8 c. Test concealed interior piping systems prior to concealment and, if system is insulated,
- 9 prior to application of insulation.
- 10 d. Test buried piping after backfilling and, if insulated, prior to application of insulation.
- 11 2. Utilize pressures, media and pressure test durations as specified on Piping Specification
- 12 Schedules.
- 13 3. Isolate equipment which may be damaged by the specified pressure test conditions.
- 14 4. All test equipment, temporary valves, bulkheads, or other water control equipment and
- 15 materials shall be determined and furnished by the CONTRACTOR subject to the
- 16 ENGINEER's review. No materials shall be used which would be injurious to the
- 17 construction or its future function.
- 18 5. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring
- 19 equipment to determine leakage rates.
- 20 a. Select each gage so that the specified test pressure falls within the upper half of the
- 21 gage's range.
- 22 b. Pressure gauges shall be ASME (ANSI) B40.1, Grade 1A or more accurate, calibrated
- 23 to an accuracy of plus or minus 1 percent minimum over the entire range of the gauge.
- 24 The gauges shall be laboratory bench tested for accuracy just prior to field hydrostatic
- 25 testing.
- 26 c. Notify the Engineer 24 HRS prior to each test.
- 27 6. Completely assemble and test new piping systems prior to connection to existing pipe
- 28 systems.
- 29 7. Keep a log of all pressure tests and report satisfactory performance of tests and inspections
- 30 in writing to Engineer prior to final acceptance.
- 31 8. Bear the cost of all testing and inspecting, locating and remedying of leaks and any
- 32 necessary retesting and re-examination.

33 B. Pressure Testing:

- 34 1. Testing medium: Unless otherwise specified in the Piping Specification Schedules, utilize
- 35 the following test media.
- 36 a. Process and plant air systems:

PIPE LINE SIZE	SPECIFIED TEST	
	PRESSURE	TESTING MEDIUM
2 IN and smaller	75 psi or less	Air or water
2 IN and smaller	Greater than 75 psi	Water
Greater than 2 IN	3 psi or less	Air or water
Greater than 2 IN	Greater than 3 psi	Water

37 b. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY	SPECIFIED TEST	TESTING MEDIUM
	OR PUMPED	PRESSURE	
Up to and including 48 IN	Gravity	25 psig or less	Air or water
All sizes	Pumped	250 psig or less	Water

38 2. Hydrostatic pressure testing methodology:

- 39 a. General:
- 40 1) All joints, including welds, are to be left exposed for examination during the test,
- 41 except buried piping.

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- 2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
- 3) Provide temporary restraints for expansion joints for additional pressure load under test.
- 4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
- 5) Do not paint or insulate exposed piping until successful performance of pressure test.
- 6) Prior to hydrostatic testing, all pipelines shall be flushed or thoroughly swept out as appropriate. The CONTRACTOR may test the pipeline in sections when all field-placed concrete and cement mortar lining for the pipe in the section is at least 14 days old and the section has been completely backfilled. The test shall be made against valves when available, or by placing temporary plugs and bulkheads in the pipe, and filling the line slowly with water. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. In no case shall the filling rate result in a flow velocity of more than 0.5 foot per second as measured using the full cross-sectional area of the pipe.
- 7) After the line, or section thereof had been completely filled, it shall be allowed to stand under a slight pressure for at least 48 hours to allow the lining to absorb what water it will and to allow the escape of air from any air pockets. During this period, the bulkheads, valves, manholes, and connections shall be examined for leaks. If any are found, these shall be stopped. The water necessary to maintain the test pressure shall be measured through a meter or by means satisfactory to the ENGINEER. CONTRACTOR shall furnish all necessary equipment and make tests at his expense.
- 8) The hydrostatic test shall consist of holding and maintaining the test pressure on the pipeline for the specified test period. The test pressure shall be measured at the highest point of the pipeline section being tested. All visible leaks shall be repaired in a manner acceptable to the ENGINEER. During the test, the entire pipeline shall be inspected to locate any leaks or breaks. Any defective joints, cracked or defective pipe, fittings, or valves discovered in consequence of this hydrostatic pressure test shall be removed and replaced with sound material and the test shall be repeated until satisfactory results are obtained.
- 9) For tests where leakage is allowed, a successful "passed" test shall be defined as a test where the amount of water required to be pumped into the piping to maintain the test pressure over the test period is less than or equal to the volume indicated by the specified leakage rate.
- 10) In the case of pipelines that fail to pass the prescribed leakage test, determine the cause of the leakage, take corrective measures necessary to repair the leaks, and again test the pipelines. The CONTRACTOR shall repeat the repairing and testing procedures until the leakage is less than the specified leakage rate, at no additional cost to the OWNER.
- 11) Pressure test valves, as installed in the field, and adjust as necessary for drip-tight performance. Valves shall be tested with pressure equal to pressure class or pipeline hydrostatic test pressure, whichever is less. Test pressure shall be applied to each side independently, and the valve tested for drip-tight performance with zero pressure on the other side of the valve. If pipeline testing is to be bulkheaded with any valve, the valve shall be tested and adjusted before the pipeline test is applied. Provisions satisfactory to the ENGINEER shall be made for verifying "0" leakage within the duration of test selected. Test duration shall be 2 hours. If pressure class of valve is less than the pipeline hydrostatic test pressure at the valve location, the valve shall then be opened for the pipeline hydrostatic test.

- 1 12) During filling and testing, the CONTRACTOR shall monitor the pipeline for signs
2 of major leakage. If major leaks are found, the testing shall be halted until the
3 leaks are fixed. Major leakage is defined as flow rates causing runoff and erosion
4 to areas outside of the pipeline easement or that may cause damage to installed
5 facilities. The CONTRACTOR shall maintain equipment on site, including
6 earthmoving equipment, to mitigate and repair any damage from major leaks.
7 13) Pipelines that fail to pass the prescribed leakage test will be considered defective
8 WORK, and the CONTRACTOR shall determine the cause of the leakage, shall
9 take corrective measures necessary to repair the leaks, and shall retest the
10 pipelines.

11 b. Soil, waste, drain and vent systems:

- 12 1) Test at completion of installation of each stack or section of piping by filling
13 system with water, pressurizing, and checking joints and fittings for leaks.
14 2) Eliminate leaks before proceeding with work or concealing piping.

15 3. Natural gas systems - testing methodology:

- 16 a. Maintain specified test pressure until each joint has been thoroughly examined for leaks
17 by means of soap suds and glycerine.
18 b. Wipe joints clean after test.

19 4. Air testing methodology:

20 a. General:

- 21 1) Assure air is ambient temperature.

22 b. Air testing:

- 23 1) Place plugs in line and inflate to required pressure.
24 2) Check pneumatic plugs for proper sealing.
25 a) Introduce air into sealed line segment until air pressure reaches required level.
26 3) Allow time for air pressure to stabilize.
27 4) After stabilization period discontinue air supply to line segment.
28 5) Record pressure at beginning and end of test.

29 C. Dielectric Testing Methods and Criteria:

- 30 1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous
31 elements of construction to assure discontinuity has been maintained.
32 2. Wherever electrical contact is demonstrated by such test, locate the point or points of
33 continuity and correct the condition.

34 **3.7 CLEANING, DISINFECTION**

- 35 A. All pipe cleaning and disinfection shall be in accordance with Section 01733.

36 **3.8 LOCATION OF BURIED OBSTACLES**

- 37 A. Furnish exact location and description of buried utilities encountered and thrust block placement.
38 B. Reference items to definitive reference point locations such as found property corners, entrances
39 to buildings, existing structure lines, fire hydrants and related fixed structures.
40 C. Include such information as location, elevation, coverage, supports and additional pertinent
41 information.
42 D. Incorporate information on "As-Recorded" Drawings.

43 **3.9 PIPE INSULATION**

- 44 A. Insulate pipe and pipe fittings in accordance with Section 15183.

45 **3.10 SCHEDULES**

46 **A. PIPING SPECIFICATION SCHEDULE - SYSTEM 1 -- NOT USED**

47 **B. PIPING SPECIFICATION SCHEDULE - SYSTEM 2**

- 48 1. General:

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- a. Piping symbol and service:
 - 1) BP - Backpulse
 - 2) BWR – Backwash Recycle.
 - 3) CCW – Cleaning Chemical Waste.
 - 4) FW – Feed Water.
 - 5) FN – Finished Water.
 - 6) PER – Permeate Water.
 - 7) RW – Raw Water.
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure:
 - a) 50 psig.
 - b) Test to pressures listed above or 1.5 times the operating pressure, whichever is greater.
 - 3) Duration: 6 HRS.
 - c. Gaskets:
 - 1) Certified ANSI/NSF 61 compliant.
 - 2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA C111.
 - 3) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.
 - 4) Flanged joints (steel): ANSI C207.
 - 5) Flange and push-on joints (PVC): Rubber, ASTM F477.
2. System components:
 - 1) Exposed Service: 18 IN PER in Membrane Building and 10 IN RW at raw water pump station.
 - a) Material: Steel, fabricated pipe.
 - b) Reference: AWWA C200.
 - c) Lining: Epoxy.
 - d) Coating: Epoxy.
 - e) Fittings: AWWA C208.
 - f) Joints: Butt-welded with rigid ANSI C207 flanges at equipment, valves, and structure penetrations. Provide grooved or shouldered mechanical couplings where indicated on drawings.
 - 2) Exposed Service: 4 through 18 IN inside Membrane Building.
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: Paint.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 IN and less and flanges at those locations for pipe above 2 IN.
 - g) Protection:
 - (1) None.
 - 3) Buried Service: 3 through 6 IN
 - a) Material: PVC, Pressure Class 200.
 - b) Reference: AWWA C900
 - c) Lining: None.
 - d) Coating: None
 - e) Fittings:
 - (1) AWWA C900 for 4-12 IN
 - f) Joints: Restrained mechanical joint with flanges at exposed valves and fittings.
 - g) Protection:
 - (1) None.
 - 4) Buried service: Larger than 6 IN

- 1 a) Materials: Ductile iron, Pressure Class 150 (minimum). If grooved type joint
- 2 system, use pipe thickness per AWWA C606.
- 3 b) Reference: ANSI C151.
- 4 c) Lining: Cement.
- 5 d) Coating: Bituminous.
- 6 e) Fittings: Either ANSI C110 ductile or gray iron. Optional ANSI C153 ductile
- 7 iron compact fittings for sizes 3 to 16 IN.
- 8 f) Joints: Restrained joint with flanges at exposed valves and fittings.
- 9 g) Protection:
- 10 (1) Polyethylene encasement.
- 11 (2) Bonded joints.

12 **C. PIPING SPECIFICATION SCHEDULE - SYSTEM 3 – NOT USED**

13 **D. PIPING SPECIFICATION SCHEDULE - SYSTEM 4 – NOT USED**

14 **E. PIPING SPECIFICATION SCHEDULE - SYSTEM 5**

15 1. General:

- 16 a. Piping symbol and service:
- 17 1) NG - Natural Gas.
- 18 b. Test requirements:
- 19 1) Test medium: Cylinder Nitrogen.
- 20 2) Pressure: 125 psig.
- 21 3) Duration: 6 HRS.

22 2. System components:

- 23 a. Pipe size: Through 26 IN.
- 24 1) Exposed service:
- 25 a) Material: Steel, Grade B, black, Schedule 40.
- 26 b) Reference: ASTM A53.
- 27 c) Lining: None.
- 28 d) Coating: Paint.
- 29 e) Fittings: Malleable iron meeting ASTM A197, ANSI B16.3, Class 150.
- 30 f) Joints: Threaded, ANSI B16.9 steel butt- or socket-welded joints.
- 31 2) Buried service:
- 32 a) Materials: Steel, Grade B, black, Schedule 40.
- 33 b) Reference: ASTM A53.
- 34 c) Linings: None.
- 35 d) Coatings: Factory coating-mill wrapped with 3-M "Scotchkote," or Energy
- 36 Coating Company "Encoat" with fittings and uncoated portions fully wrapped
- 37 after testing with 3-M "Scotchkote" tape or equal.
- 38 e) Fittings: Malleable iron meeting ASTM A197, ANSI B16.3, Class 150.
- 39 f) Joints: Threaded or ANSI B16.9 steel butt- or socket-welded joints.

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41 **Natural Gas Piping Installation:**

- 42 1. Install piping in accordance with NFPA, local gas company regulations, codes and local
- 43 ordinances, complete with necessary appurtenances.
- 44 2. Install buried pipe at approximately 30 IN deep.
- 45 3. Gas cocks:
- 46 a. Install before gas utilization equipment connected to system, at each branch main and at
- 47 connection to meter.
- 48 b. Design to operate safely under pressures indicated.
- 49 c. Install ground joint unions at intervals to facilitate repairs.
- 50 d. Cocks shall be of type and lubricant recommended by manufacturer for this class of
- 51 service, and as approved by local gas company.
- 52 4. Pipe drainage:
- 53 a. Drain horizontal piping to risers.
- 54 b. Locate drains where required for system drainage.

- c. Install tee fitting with bottom outlet plugged or provide with threaded, capped nipple at bottom of risers or in accordance with applicable codes.
5. Make piping connections with shellacked joints or ground joint unions.
6. Provide vents from gas regulators, pressure reducing valves, and other vented devices to the outdoors and terminate in accordance with applicable codes.
7. Connect piping to pressure reducing valve outside each building as shown on drawings and schedule.
8. Provide flexible connections to vibration isolated equipment suitable for pressures, local and national codes and intended application.
9. Remove cutting and threading burrs.
10. Plug each gas outlet (including valves) with threaded plugs or caps immediately after installation and retain until the piping or equipment connections are completed.
11. Continuously ground gas piping electrically, bond tightly to the grounding connection.
12. Install piping parallel to other piping, but maintain a minimum 12 IN clearance between gas piping and any piping that could reach 200 DegF.

F. PIPING SPECIFICATION SCHEDULE - SYSTEM 6 - NOT USED

G. PIPING SPECIFICATION SCHEDULE - SYSTEM 7

1. General:
 - a. Piping symbol and service:
 - 1) CLS - Chlorine Solution.
 - 2) CAS - Citric Acid Solution.
 - 3) FES - Ferric Sulfate Solution.
 - 4) SBS - Sodium Bisulfite Solution.
 - 5) SHS - Sodium Hydroxide Solution.
 - b. Test requirements pressure lines:
 - 1) Test medium: Water or air.
 - 2) Pressure: 200 psig.
 - 3) Duration: 6 HRS.
 - c. Gaskets and O-rings:
 - 1) Chlorine Institute Standard for CLS
 - 2) Compatible with product conveyed at a minimum product temperature of 150 degF.
 - d. Solvent for CLS piping must be compatible with CLS.
2. System components:
 - a. Pipe size: 12 IN and smaller.
 - 1) Exposed service:
 - a) Material: PVC, Schedule 80.
 - (1) Provide piping as shown on Drawings
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: Paint.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 IN and less and flanges at those locations for pipe above 2 IN.
 - b. Pipe size: All sizes
 - 1) Buried Service
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2466.
 - f) Joints: Solvent welded. Solvent for CLS piping must be compatible with CLS.
 - g) Protection:

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(1) None.

H. PIPING SPECIFICATION SCHEDULE - SYSTEM 8 – NOT USED.

I. PIPING SPECIFICATION SCHEDULE - SYSTEM 9– NOT USED.

J. PIPING SPECIFICATION SCHEDULE - SYSTEM 10

1. General:

- a. Piping symbol and service:
 - 1) NPW – Nonpotable Water.
 - 2) PWC - Potable Water Cold.
 - 3) PWH – Potable Water Hot.
 - 4) SVW – Service Water
- b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 200 psig.
 - 3) Duration: 6 HRS.
- c. Gaskets and O-rings:
 - 1) O-rings: Neoprene or rubber.
 - 2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA C111.
 - 3) Flanged joints (steel): Rubber, ANSI C207.
 - 4) Grooved coupling joints (ductile and steel): Rubber, AWWA C606.

2. System components:

- a. Pipe size: To 3 IN.
 - 1) Exposed service for PWC and PWH:
 - a) Material: Copper tubing, Type L.
 - b) Solder: Cadmium and lead-free solder compatible with tubing and fittings materials.
 - c) Reference: ASTM B88.
 - d) Lining: None.
 - e) Coating: Paint.
 - f) Fittings: Wrought copper or bronze fittings meeting ANSI B16.22.
 - g) Joints: Soldered or brazed with unions at valves and equipment or as an alternate for size 1/2 IN to 2 IN the joints may be of the pressed type. Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.
 - 2) Exposed service for NPW and SVW:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: Paint.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 IN and less and flanges at those locations for pipe above 2 IN.
 - 3) Buried service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2466.
 - f) Joints: Solvent welded.
 - g) Protection
 - (1) None.
- b. Pipe size: 3 through 12 IN.
 - 1) Exposed service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.

- 1 b) Reference: ASTM D1785.
- 2 c) Lining: None.
- 3 d) Coating: Paint.
- 4 e) Fittings: Solvent welded socket type complying with ASTM D2467.
- 5 f) Joints: Solvent welded with unions at valves, penetrations through structures
- 6 and equipment connections for pipe 2 IN and less and flanges at those
- 7 locations for pipe above 2 IN.
- 8 2) Buried Service:
- 9 a) Material: PVC, Pressure Class 200.
- 10 b) Reference: AWWA C900
- 11 c) Lining: None.
- 12 d) Coating: None
- 13 e) Fittings:
- 14 (1) AWWA C900 for 4-12 IN
- 15 f) Joints: Restrained mechanical joint with flanges at exposed valves and
- 16 fittings.
- 17 g) Protection:
- 18 (1) None.
- 19 3. Install drain tees with capped nipples of same material as piping 3 IN long at low points. If
- 20 low point occurs in concealed piping, provide approved flush access panel. These drains are
- 21 not shown on Drawings.
- 22 4. Slope water lines down to drain points not less than 1 IN in 60 FT.
- 23 5. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed
- 24 after cutting to remove burrs. Pipe joint cement permitted only on external threads.
- 25 6. Install ball, butterfly and plug valves where indicated or required to adequately service all
- 26 parts of system and equipment.
- 27 7. Install unions between valves and connections to each piece of equipment, and install
- 28 sufficient number of unions throughout piping system to facilitate installation and servicing.
- 29 8. Where exposed pipes 6 IN in size and smaller pass through floors, finished walls, or
- 30 finished ceilings, fit with nickel or chrome-plated plates large enough to completely close
- 31 hole around pipes. Secure plates to pipe by set screw in approved manner.
- 32 9. Install piping so as to be free to expand with proper loops, anchors and joints without injury
- 33 to system or structure.
- 34 10. Provide branches to wall hydrants or hose bibbs in exterior locations with interior shutoff
- 35 and drain valves.
- 36 11. Install concealed in finished structures such as administration and office facilities and at
- 37 locations shown on Drawings.

38 **K. PIPING SPECIFICATION SCHEDULE - SYSTEM 11 – NOT USED**

39 **L. PIPING SPECIFICATION SCHEDULE - SYSTEM 13**

- 40 1. General:
- 41 a. Piping symbol and service in the Membrane Building:
- 42 1) CA – Control Air.
- 43 2) PA – Process Air.
- 44 b. Test requirements:
- 45 1) Test medium: Air.
- 46 2) Pressure: 150 psig.
- 47 3) Greater than 2 IN : 200 psig.
- 48 4) Duration: 6 HRS.
- 49 c. Gaskets:
- 50 1) Flanged joints: AISI 304 stainless steel, spiral wound, non-asbestos filler, 3/16 IN
- 51 thick with compression ring to match required flange dimensions.
- 52 2. System components:
- 53 a. Pipe size: To 1 IN for CA and PA.
- 54 1) Exposed service:

- a) Material: Stainless steel tubing, TP-304L.
 - b) Reference: ASTM A269.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Stainless steel 304L. Compression type tube fittings.
 - f) Joints: Compression type couplings, unions at equipment and valves.
- b. Pipe size: Greater than 1 IN for PA.
 - 1) Exposed service:
 - a) Materials: Steel, Grade B, black. Schedule 40.
 - b) Reference: ASTM A53.
 - c) Linings: None.
 - d) Coating: Paint.
 - e) Fittings: Malleable iron meeting ANSI B16.3, ASTM A197 or steel meeting ASTM A106, Grade B.
 - f) Joints: Welded with flanges at equipment and valves. Harnesses compression sleeve couplings as needed to allow for expansion and contraction.

M. PIPING SPECIFICATION SCHEDULE -SYSTEM 14 – NOT USED

N. PIPING SPECIFICATION SCHEDULE - SYSTEM 15 – NOT USED

O. PIPING SPECIFICATION SCHEDULE - SYSTEM 16 – NOT USED

P. PIPING SPECIFICATION SCHEDULE - SYSTEM 17 – NOT USED.

Q. PIPING SPECIFICATION SCHEDULE - SYSTEM 18 – NOT USED.

R. PIPING SPECIFICATION SCHEDULE - SYSTEM 19 – NOT USED.

S. PIPING SPECIFICATION SCHEDULE - SYSTEM 20 – NOT USED.

T. PIPING SPECIFICATION SCHEDULE - SYSTEM 21 – NOT USED

U. PIPING SPECIFICATION SCHEDULE - SYSTEM 22 – NOT USED.

V. PIPING SPECIFICATION SCHEDULE - SYSTEM 23 – NOT USED

W. PIPING SPECIFICATION SCHEDULE - SYSTEM 24 – NOT USED.

X. PIPING SPECIFICATION SCHEDULE - SYSTEM 25 – NOT USED.

Y. PIPING SPECIFICATION SCHEDULE - SYSTEM 26 – NOT USED.

Z. PIPING SPECIFICATION SCHEDULE - SYSTEM 27

1. General:

- a. Piping symbol and service:
 - 1) CHV – Chemical Vent.
 - 2) D – Drain Line
 - 3) SAM - Sample.
 - 4) SMD – Sample Drain.
 - 5) VT – Vent.
 - 6) VTR -- Vent through roof.
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 25 psig all pipe except SAM. SAM shall be tested at 150 psi.
 - 3) Duration: 6 HRS.
 - 4) See Section 02740 for additional requirements for SAN piping.
 - c. Gaskets and O-rings:
 - 1) O-rings and flanged joints: Neoprene or rubber.
2. System components:
- a. Pipe size: 12 IN and smaller.
 - 1) Exposed service:

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- a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: Paint.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 IN and less and flanges at those locations for pipe above 2 IN.
- 2) Buried service:
- a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2466.
 - f) Joints: Solvent welded.
3. Vent Piping Installation:
- a. Run vent stack parallel to each soil or waste stack to receive branch vents from fixtures.
 - b. Originate each vent stack from soil or waste pipe at its base.
 - c. Where possible, combine soil, waste or vent stacks before passing through roof so as to minimize roof openings.
 - d. Offset pipes running close to exterior walls away from such walls before passing through roof to permit proper flashing.
 - e. Provide pipes passing through roofs with cast iron increasers minimum of 12 IN below roof one size larger than pipe but in no case less than 4 IN.
 - f. Terminate each vent with approved frostproof jacket.
 - g. Carry vent stacks 4 IN and larger full size through roof. Extend vent stacks at least 12 IN above roofing.
 - h. Pipe vents from pressure regulating devices in compliance with local codes.
 - i. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

AA. PIPING SPECIFICATION SCHEDULE - SYSTEM 28 – NOT USED

END OF SECTION

2 **SECTION 15061**
3 **PIPE - STEEL**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Steel pipe, fittings, and appurtenances.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 01340 – Submittals.
12 4. Section 09905 - Painting and Protective Coatings.
13 5. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
14 6. Section 15090 – Pipe Support Systems.

15 **1.2 QUALITY ASSURANCE**

- 16 A. Referenced Standards:
17 1. American National Standards Institute (ANSI):
18 a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
19 b. B2.1, Gages and Gaging for Unified Inch Screw Threads.
20 c. B16.3, Malleable Iron Threaded Fittings.
21 d. B16.5, Pipe Flanges and Flanged Fittings.
22 e. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
23 f. B16.11, Forged Steel Fittings, Socket Welding and Threaded.
24 g. B31.9, Building Services Piping.
- 25 2. ASTM International (ASTM):
26 a. A36, Standard Specification for Carbon Structural Steel.
27 b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated
28 Welded and Seamless.
29 c. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature
30 Service.
31 d. A181, Standard Specification for Forgings, Carbon Steel, for General-Purpose Piping.
32 e. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy
33 Steel for Moderate and Elevated Temperatures.
34 f. A283, Low and Intermediate Tensile Strength Carbon Steel Plates.
35 g. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
36 Strength.
37 h. A570, Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural
38 Quality.
39 i. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium
40 Structural Steel.
41 j. B6, Standard Specification for Zinc.
42 k. D1330, Rubber Sheet Gaskets.
- 43 3. American Water Works Association (AWWA):
44 a. C200, Steel Water Pipe 6 IN and Larger.
45 b. C205, Standard for Cement-Mortar Lining and Coating for Steel Water Pipe 4 IN and
46 Larger Shop Applied.
47 c. C206, Field Welding of Steel Water Pipe.
48 d. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 IN through 144 IN.
49 e. C208, Dimensions for Fabricated Steel Water Pipe Fittings.

- f. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- g. C210, Standard for Liquid Epoxy Coating Systems for Interior and Exterior of Steel Water Pipelines.
- h. C606, Grooved and Shouldered Joints.
- i. Manual M11, Steel Pipe - A Guide for Design and Installation.

B. Qualifications:

- 1. Pipe and fittings shall be the product of one manufacturer that has at least five (5) years of successful experience manufacturing pipe and fittings of the particular type and size indicated. Pipe manufacturing operations (pipe, fittings, lining, coating) shall be performed at one location and shall comply with these specifications as applicable. The lining shall be shop applied spun cement-mortar lining. The manufacturer shall be certified under SPFA quality certification program for steel pipe and accessory manufacturing.
- 2. Application of coating material including preparation of surfaces and coating of pipe, fittings, and specials in shop, repairs of any coating damage occurring during shipment or any other time, and field coating of ends where coatings have been held back for welded field joints, shall be done by an established and recognized coating applicator acceptable to Engineer. Coating manufacturer shall have a minimum of five (5) years of successful experience in the production and application of the polyurethane coating specified.
- 3. Use only certified welders meeting procedures and performance outlined in Section 9 of the ASME, Section 3.3.3 of AWWA C200 and other codes and requirements per local building and utility requirements.
- 4. Contractor shall have demonstrated experience in the procurement and installation of steel pipe of the size and class specified herein.

C. Factory Testing:

- 1. Pipe manufacturer shall perform all tests as required by the applicable AWWA standards and as listed herein.
- 2. Pressure testing:
 - a. Each joint of pipe shall be hydrostatically pressure tested prior to application of lining and coating. The internal test pressure shall be that which results in a fiber stress equal to 75% of the minimum yield strength of the steel used. Each joint of pipe tested shall be completely watertight under the maximum test pressure. Pipe manufacturer shall maintain a record of the pressure, duration, and mark number for each pressure test.
 - b. Fittings shall be fabricated from hydrostatically tested pipe. Fittings shall be tested by hydrostatic test, air test, magnetic particle test, or dye penetrant test. Air test shall be made by applying air to the welds under 10 PSI and checking for leaks around and through the welds with a soap solution.
- 3. Lining:
 - a. Test shop-applied cement-mortar lining in accordance with AWWA C205

1.3 SUBMITTALS

A. Shop Drawings:

- 1. See Section 15060.
- 2. Factory test reports.
- 3. If mechanical grooved type coupling system is used, submit piping, fittings, and appurtenant items which will be utilized.
- 4. Welders certificates.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 1 1. Flanged adaptors:
 - 2 a. Rockwell (Style 913 (steel)).
 - 3 b. Dresser (Style 128 (steel)).
- 4 2. Reducing couplings:
 - 5 a. Rockwell (Style 415).
 - 6 b. Dresser (Style 62).
- 7 3. Transition coupling:
 - 8 a. Rockwell (Style 413).
 - 9 b. Dresser (Style 62).
- 10 4. Compression sleeve coupling:
 - 11 a. Rockwell (Style 411 (steel)).
 - 12 b. Dresser (Style 38 (steel)).
- 13 5. Mechanical couplings and fittings (Grooved and Shouldered):
 - 14 a. Victaulic Style 770.
- 15 B. Submit requests for substitution in accordance with Specification Section 01640.

16 **2.2 MATERIALS**

- 17 A. All materials used in steel piping systems defined in Section 15060 shall meet or exceed
 - 18 pressure test requirements specified for each respective system.
- 19 B. Steel Pipe (Fabricated Type):
 - 20 1. AWWA C200:
 - 21 a. ASTM A36, Grade C Steel Plate.
 - 22 b. ASTM A283, Grade D Steel Plate.
 - 23 c. ASTM A570, Steel Sheet.
 - 24 d. ASTM A572, Steel Plate.
 - 25 C. Steel Pipe (Mill Type):
 - 26 1. ASTM A53, Type E or S.
 - 27 D. Fittings (For Fabricated Pipe):
 - 28 1. AWWA C208.
 - 29 E. Fittings (For Mill Type Pipe):
 - 30 1. ASTM A234.
 - 31 2. ANSI B16.3.
 - 32 3. ANSI B16.5.
 - 33 4. ANSI B16.9.
 - 34 5. ANSI B16.11.
 - 35 F. Flanges (Fabricated Pipe):
 - 36 1. Flange material: ASTM A283, Grade C or D, ASTM A181 Grade 1.
 - 37 2. Flange finish: Flat faced.
 - 38 G. Flanges (Mill Type Pipe):
 - 39 1. ANSI B16.5.
 - 40 2. Flat faced.
 - 41 3. Weld-neck or Butt-weld flanges.
 - 42 H. Nuts and Bolts:
 - 43 1. Exposed: Mechanical galvanized ASTM B695, Class 40.
 - 44 2. Heads and dimensions per ANSI B1.1.
 - 45 3. Threaded per ANSI B1.1.
 - 46 4. Project ends 1/4 to 1/2 IN beyond nuts.
 - 47 I. Gaskets: See individual piping systems in Section 15060.

48 **2.3 MANUFACTURED UNITS**

- 49 A. Couplings:

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- 1. Flanged adaptors:
 - a. Steel or carbon steel body sleeve, flange, followers and Grade 30 rubber gaskets.
 - b. Provide units equal to those specified in Article 2.1.
 - c. Flanges meeting standards of adjoining flanges.
 - d. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
- 2. Compression sleeve coupling:
 - a. Steel sleeve, followers Grade 30 and rubber gaskets.
 - b. Provide units equal to those specified in Article 2.1.
 - c. Flanges meeting standards of adjoining flanges.
 - d. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
- 3. Mechanical coupling joint:
 - a. Use of mechanical grooved (AWWA C606) type couplings and fittings in lieu of flanged joints is acceptable where specifically specified in Section 15060.
 - b. Utilize units defined in Article 2.1.

17 **2.4 FABRICATION**

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- A. Provide piping (mill or fabricated) for use in this Project with minimum wall thicknesses as follows:
 - 1. 1/8 - 5 IN DIA pipe: Schedule 40.
 - 2. 6 - 10 IN DIA pipe: 3/16 IN.
 - 3. 12 - 14 IN DIA pipe: 7/32 IN.
 - 4. 16 - 48 IN DIA pipe: 1/4 IN.
 - 5. Sizes through 24 IN are nominal OD. Sizes greater than 24 are ID.
 - 6. Wall thicknesses indicated are for standard weight pipe. Design pipe in accordance with operating pressures shown in Piping Schedules for a design stress limited to 50 percent of yield.
- B. Fabricated Fittings:
 - 1. AWWA C208.
 - 2. Assure ratio of radius of bend to diameter of pipe equal to or greater than 1.0.
- C. Taper cement mortar linings as required for valve interfacing.

32 **2.5 PROTECTIVE COATINGS AND LININGS:**

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- A. Furnish without outside coating of bituminous material any exposed pipe scheduled to be painted.
- B. Pipe Linings:
 - 1. Provide epoxy lining in accordance with AWWA C210.
- C. Pipe Coatings:
 - 1. Painting and protective coatings in accordance with Section 09905.
 - 2. Field paint pipe in accordance with Section 09905.

40 **2.6 SOURCE QUALITY CONTROL**

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- A. Testing:
 - 1. Shop hydrostatic test fabricated steel pipe and fittings.
 - 2. Field hydrostatic test all pipe as specified in Section 15060.

44 **PART 3 - EXECUTION**

45 **3.1 INSTALLATION**

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- A. Install products in accordance with manufacturer's instructions.

1 B. Joining Methods - Flanges:

2 1. Facing method:

- 3 a. Insert slip-on flange on pipe.
4 b. Assure maximum tolerances for flange faces from normal with respect to axis of pipe is
5 0.005 IN per foot of flange diameter.
6 c. Test flanges after welding to pipe for true to face condition and reface, if necessary, to
7 bring to specified tolerance.

8 2. Joining method:

- 9 a. Leave 1/8 to 3/8 IN of flange bolts projecting beyond face of nut after tightening.
10 b. Coordinate dimensions and drillings of flanges with flanges for valves, pumps,
11 equipment, tank, and other interconnecting piping systems.
12 c. When bolting flange joints, exercise extreme care to assure that there is no restraint on
13 opposite end of pipe or fitting which would prevent uniform gasket compression or
14 cause unnecessary stress, bending or torsional strains being applied to cast flanges or
15 flanged fittings. Allow one flange free movement in any direction while bolts are being
16 tightened.
17 d. Do not assemble adjoining flexible coupled, mechanical coupled or welded joints until
18 flanged joints in piping system have been tightened.
19 e. Gradually tighten flange bolts uniformly to permit even gasket compression.
20 f. Do not overstress bolts to compensate for poor installation.

21 C. Joining Method - Welded Joints:

- 22 1. Perform welding in accordance with AWWA C206 and this Section.
23 2. For flange attachment perform in accordance with AWWA C207.
24 3. Have each welding operator affix an assigned symbol to all his welds. Mark each
25 longitudinal joint at the extent of each operator's welding. Mark each circumferential joint,
26 nozzle, or other weld into places 180 degrees apart.
27 4. Welding for all process piping shall conform with ANSI B31.3. Welding of utility piping
28 125 psi and less shall be welded per ANSI B31.9. Utility piping above 125 psi shall
29 conform to ANSI B31.1.
30 5. Provide caps, tees, elbows, reducers, etc. manufactured for welded applications.
31 6. Weldolets may be used for 5 IN and larger pipe provided all slag is removed from inside the
32 pipe.
33 7. Weld-in nozzles may be used for branch connections to mains and where approved by
34 Engineer.
35 8. Use all long radius welding elbows for expansion loops and bends.
36 9. Use long radius reducing welding elbows 90 degree bends and size changes are required.

37 D. Joining Method - Couplings:

38 1. Compression sleeve:

- 39 a. Install coupling to allow space of not less than 1/4 IN but not more than 1 IN.
40 b. Provide harnessed joint. Use joint harness arrangements detailed in AWWA M11.
41 c. Design harness assembly with adequate number of tie rods for test pressures indicated
42 in Section 15060 and allow for expansion of pipe.
43 d. Provide ends to be joined or fitted with compression sleeve couplings of the plain end
44 type.
45 e. Grind smooth welds the length of one coupling on either side of joint to be fitted with
46 any coupling.
47 f. Assure that outside diameter and out-of-round tolerances are within limits required by
48 coupling manufacturer.

49 2. Mechanical coupling:

- 50 a. Arrange piping so that pipe ends are in full contact.
51 b. Groove and shoulder ends of piping in accordance with manufacturer's
52 recommendations.
53 c. Provide coupling and grooving technique assuring a connection which passes pressure
54 testing requirements.
55 d. Provide additional pipe supports either side of coupling for couplings that are not rigid.

- 1 E. Joining Method - Threaded and Coupled (T/C):
- 2 1. Provide T/C end conditions that meet ANSI B2.1 requirements.
- 3 2. Furnish pipe with factory-made T/C ends.
- 4 3. Field cut additional threads full and clean with sharp dies.
- 5 4. Leave not more than three pipe threads exposed at each branch connection.
- 6 5. Ream ends of pipe after threading and before assembly to remove burrs.
- 7 6. Use Teflon thread tape on male thread in mating joints.
- 8 F. Support exposed piping in accordance with Section 15060.
- 9 **3.2 FIELD QUALITY CONTROL**
- 10 A. Test piping systems in accordance with Section 15060.
- 11 **3.3 DISINFECTION**
- 12 A. For potable water mains, observe disinfection methods described in Section 01733.

END OF SECTION

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2 **SECTION 15062**
3 **PIPE - DUCTILE**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Ductile iron piping, fittings, and appurtenances.
8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 01340 - Submittals.
12 4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:
15 1. American National Standards Institute (ANSI):
16 a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
17 b. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
18 c. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
19 2. ASTM International (ASTM):
20 a. A183, Carbon Steel Track Bolts.
21 b. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for
22 High-Temperature Service.
23 c. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
24 Strength.
25 d. D1330, Rubber Sheet Gaskets.
26 3. American Water Works Association (AWWA):
27 a. C104, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
28 b. C105, Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and
29 Other Liquids.
30 c. C110, Ductile Iron and Gray Iron Fittings, 3 IN through 48 IN for Water and Other
31 Liquids.
32 d. C111, Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.
33 e. C115, Flanged Ductile Iron Pipe with Threaded Flanges.
34 f. C150, Thickness Design of Ductile Iron Pipe.
35 g. C151, Ductile Iron Pipe, Centrifugally Cast-In-Metal Molds or Sand-Lined Molds, for
36 Water or Other Liquids.
37 h. C153, Ductile-Iron Compact Fittings, 3 in. through 16 in. for Water and Other Liquids.
38 i. C606, Grooved and Shouldered Joints.

39 **1.3 SUBMITTALS**

- 40 A. Shop Drawings:
41 1. See Section 15060.
42 2. Certification of factory hydrostatic testing.
43 3. If mechanical coupling system is used, submit piping, fittings, and appurtenant items which
44 will be utilized to meet system requirements.
45 4. Provide design calculations for piping materials per design conditions specified.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents the following manufacturers are acceptable:

- 4 1. Ductile Iron Pipe:
5 a. American Ductile Iron Pipe.
6 b. U.S. Pipe.
7 c. Griffin Pipe.
8 d. Tyler Pipe.
9 e. McWane
10 2. Flanged adapters:
11 a. Rockwell (Style 912 (cast)).
12 b. Dresser (Style 127 (cast)).
13 c. Or approved equal.
14 3. Mechanical coupling (grooved type):
15 a. Victaulic (Style 31).
16 b. Tyler.
17 c. Or approved equal.
18 4. Reducing couplings:
19 a. Rockwell (Style 415).
20 b. Dresser (Style 62).
21 5. Transition coupling:
22 a. Rockwell (Style 413).
23 b. Dresser (Style 62).
24 c. Or approved equal.
25 6. Polyethylene encasement tape:
26 a. As specified in Section 13110.
27 7. Restrained joints:
28 a. American Flex Ring
29 b. American Lok-Ring
30 c. US Pipe TR Flex
31 d. Griffin SNAP-LOK
32 e. Or approved equal.

33 B. Submit requests for substitution in accordance with Specification Section 01640.

34 **2.2 MATERIALS**

35 A. All portions of ductile iron pipe in contact with water shall be ANSI-NSF 61 approved.

- 36 B. Ductile Iron Pipe:
37 1. AWWA C115.
38 2. AWWA C150.
39 3. AWWA C151.

- 40 C. Fittings and Flanges:
41 1. AWWA C110.
42 2. AWWA C115.
43 3. Flanges drilled and faced per ANSI B16.1 for both 125 and 250 psi applications.

- 44 D. Nuts and Bolts:
45 1. Buried: Cadmium-plated meeting Military Specification QQ-P-416F, Type 1, Class 2 (Cor-
46 Ten) for buried application. Exposed: Mechanical galvanized ASTM B695, Class 40.
47 2. Heads and dimensions per ANSI B1.1.
48 3. Threaded per ANSI B1.1.
49 4. Project ends 1/4 to 1/2 IN beyond nuts.

- 1 E. Gaskets: See individual piping system requirements in Section 15060 and compatible with fluid
2 in piping.
- 3 F. If mechanical coupling system is used, utilize pipe thickness and grade in accordance with
4 AWWA C606.
- 5 G. See Piping Schedules in Section 15060.

6 2.3 MANUFACTURED UNITS

- 7 A. Couplings:
- 8 1. Flanged adapters:
- 9 a. Unit consisting of steel or carbon steel body sleeve, flange, followers, gaskets to be
10 compatible with fluid in piping.
- 11 b. Provide units equal to those specified in Article 2.1.
- 12 c. Supply flanges meeting standards of adjoining flanges.
- 13 d. Rate entire assembly for test pressure specified on piping schedule for each respective
14 application.
- 15 2. Compression sleeve coupling:
- 16 a. Unit consisting of steel sleeve, followers, gaskets to be compatible with fluid in piping.
- 17 b. Provide units equal to those specified in Article 2.1.
- 18 c. Supply flanges meeting standards of adjoining flanges.
- 19 d. Entire assembly to be rated for test pressure specified on piping schedule for each
20 respective application.
- 21 e. Provide field coating for buried couplings per AWWA C203.
- 22 3. Mechanical couplings:
- 23 a. Use of mechanical couplings and fittings in lieu of flanged joints is acceptable where
24 specifically specified in Section 15060. Utilize units defined in Article 2.1.

25 2.4 FABRICATION

- 26 A. Furnish and install without outside coatings of bituminous material any exposed pipe scheduled
27 to be painted.
- 28 B. Furnish cast parts with lacquer finish compatible with finish coat.

29 2.5 LININGS AND COATINGS

- 30 A. Furnish and install without outside coatings of bituminous material any exposed pipe scheduled
31 to be painted.
- 32 B. Furnish cast parts with lacquer finish compatible with finish coat.
- 33 C. Cement Lining:
- 34 1. In accordance with AWWA C104.
- 35 D. Buried pipe shall be wrapped and installed with polyethylene film in accordance with AWWA
36 C105, Method A.
- 37 E. Buried couplings shall be heat shrink wrapped.
- 38 1. Cross-linked polyolefin wrap or sleeve with a mastic sealant.
- 39 2. Comply with AWWA C216 and manufacturer's recommendations.
- 40 3. Minimum thickness: 60 mils.
- 41 4. Overlap polyurethane coating on pipe by a minimum of 3 IN on each side of joint. Width of
42 heat shrink sleeve shall take into consideration shrinkage of sleeve due to installation and
43 joint profile. Overlapping of two or more heat shrink sleeves to achieve the necessary width
44 will not be permitted.
- 45 5. Acceptable manufacturers:
- 46 a. Canusa.
- 47 b. Raychem.
- 48 c. Or approved equal.

- 1 F. Exterior coating shall consist of a nominal one-mil thick asphaltic material applied to the outside
2 of the pipe as described in Section 51.8 of AWWA C151.

3 **2.6 SOURCE QUALITY CONTROL**

4 A. Factory Test:

- 5 1. Subject pipe to hydrostatic test of not less than 500 psi with the pipe under the full test
6 pressure for at least 10 seconds. Test shall be conducted according to the requirements set
7 forth in AWWA C151 unless otherwise specified.

8 **PART 3 - EXECUTION**

9 **3.1 INSTALLATION**

10 A. Joining Method - Push-On Mechanical (Gland-Type) Joints:

- 11 1. Install in accordance with AWWA C111.
12 2. Assemble mechanical joints carefully according to manufacturer's recommendations.
13 3. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
14 4. Do not overstress bolts.
15 5. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation
16 of harness bolts.
17 6. Provide restrained joints on all piping except for piping at entrance/exits from structures or
18 where piping goes under a structure. Restrained joints shall be as recommended by the pipe
19 manufacturer.

20 B. Joining Method - Push-On Joints:

- 21 1. Install in accordance with AWWA C151.
22 2. Assemble push-on joints in accordance with manufacturer's directions.
23 3. Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket. Use
24 lubricant that is non-toxic, does not support the growth of bacteria, has no deteriorating
25 effects on the gasket material, and imparts no taste or odor to water in pipe.
26 4. Assure the gasket groove is thoroughly clean.
27 5. For cold weather installation, warm gasket prior to placement in bell.
28 6. Taper of bevel shall be approximately 30 degrees with centerline of pipe and approximately
29 1/4 IN back.

30 C. Joining Method - Flanged Joints:

- 31 1. Install in accordance with AWWA C115.
32 2. Extend pipe completely through screwed-on flanged and machine flange face and pipe in
33 single operation.
34 3. Make flange faces flat and perpendicular to pipe centerline.
35 4. When bolting flange joints, exercise extreme care to ensure that there is no restraint on
36 opposite end of pipe or fitting which would prevent uniform gasket compression or would
37 cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged
38 fittings.
39 5. Allow one flange free movement in any direction while bolts are being tightened.
40 6. Do not assemble adjoining flexible joints until flanged joints in piping system have been
41 tightened.
42 7. Gradually tighten flange bolts uniformly to permit even gasket compression.

43 D. Joining Method - Mechanical Coupling Joint:

- 44 1. Arrange piping so that pipe ends are in full contact.
45 2. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
46 3. Provide coupling and grooving technique assuring a connection which passes pressure
47 testing requirements.

48 E. Flange Adapters 12 IN and Less:

- 49 1. Locate and drill holes for anchor studs after pipe is in place and bolted tight.

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SECTION 15063

3

PIPE - COPPER

4 PART 1 - GENERAL

5 1.1 SUMMARY

6

A. Section Includes:

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1. Copper piping, fittings, and appurtenances.

8

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

9

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

10

2. Division 1 - General Requirements.

11

3. Section 02221 - Trenching, Backfilling, and Compacting for Utilities.

12

4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

13

5. Section 15090 - Pipe Support Systems.

14

1.2 QUALITY ASSURANCE

15

A. Referenced Standards:

16

1. American National Standards Institute (ANSI):

17

- a. B16.18, Cast Bronze Solder - Joint Pressure Fittings.

18

- b. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.

19

- c. B16.23, Cast Bronze Solder Joint Drainage Fittings - DWV.

20

- d. B16.24, Bronze Flanges and Flanged Fittings, 150 and 300 LBS.

21

- e. B16.26, Cast Bronze Alloy Fittings for Flared Copper Tubes.

22

2. ASTM International (ASTM):

23

- a. B32, Solder Metal.

24

- b. B88, Seamless Copper Water Tube (ANSI H23.1).

25

- c. B306, Copper Drainage Tube (DWV) (ANSI H23.6).

26

3. American Welding Society (AWS):

27

- a. A5.8, Brazing Filler Material.

28

1.3 SUBMITTALS

29

- A. See Section 15060.

30

PART 2 - PRODUCTS

31

2.1 MATERIALS

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A. Copper Tubing:

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1. Pressure non-buried: ASTM B88, Type L hard.

34

2. Non-pressure: ASTM B306.

35

B. Copper Pipe: ASTM B42, regular strength.

36

C. Fittings:

37

1. Pressure non-buried: ANSI B16.22.

38

2. Non-pressure: ANSI B16.23

39

D. Soldering and Brazing:

40

1. Non-buried:

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- a. ASTM B32 solder with a tin/antimony ratio of 95/5 and non-corrosive flux up to 180

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DegF water temperature.

2 **SECTION 15064**
3 **PIPE - PLASTIC**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Plastic pipe.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 02221 – Trenching, Backfilling, and Compacting for Utilities.
12 4. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
13 5. Section 15090 – Pipe Support Systems.

14 **1.2 QUALITY ASSURANCE**

- 15 A. See Section 15060.
- 16 B. Referenced Standards:
17 1. ASTM International (ASTM):
18 a. PVC (polyvinyl chloride) materials:
19 1) D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds
20 and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
21 2) D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe,
22 Schedules 40, 80, and 120.
23 3) D2241, (PVC) Plastic Pipe (SDR-PR and Class T).
24 4) D2464, Threaded (PVC) Plastic Pipe Fittings, Schedule 80.
25 5) D2466, Socket Type (PVC) Plastic Pipe Fittings, Schedule 40.
26 6) D2467, Socket Type (PVC) Plastic Pipe Fittings, Schedule 80.
27 7) D2564, Solvent Cements for (PVC) Plastic Pipe, Tubing, and Fittings.
28 8) D3034, Type PSM - PVC Sewer Pipe and Fittings.
29 9) D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible
30 Elastomeric Seals.
31 10) D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using
32 Flexible Elastomeric Seals.
33 11) F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
34 b. Installation:
35 1) D2321, Underground Installation of Flexible Thermosplastic Sewer Pipe.
36 2) D2855, Making Solvent Cemented Joints with PVC Pipe and Fittings.
- 37 2. American Water Works Association (AWWA):
38 a. PVC (polyvinyl chloride) materials:
39 1) C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in.
40 Through 12 in (100 mm Through 300 mm), for Water Distribution..

41 **1.3 SUBMITTALS**

- 42 A. See Section 15060.

43 **PART 2 - PRODUCTS**

44 **2.1 MATERIALS**

1 A. All materials in contact with water shall be ANSI/NSF 61 approved.

2 **2.2 PVC PRESSURE PIPING – SCHEDULE 80**

3 A. General: Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances to locations
4 shown on Drawings. Furnish materials in full compliance to following material specifications:

5 1. Manufacture pipe, fittings and appurtenances from polyvinyl chloride (PVC) compound
6 which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined
7 in ASTM D1784.

8 B. Manufacture pipe, fittings and valves from materials that have been tested and approved for
9 conveying potable water by the National Sanitation Foundation (NSF).

10 C. Pipe:

11 1. Furnish pipe meeting requirements of ASTM D1785. Pipe 2 IN and less to be solvent
12 welded. Pipe larger than 2 IN may be either flanged or solvent welded unless shown
13 otherwise on Drawings.

14 D. Fittings:

15 1. Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature
16 rating as the pipe.

17 2. Fabricated fitting are not acceptable.

18 E. Flanges/Unions:

19 1. Furnish flanges and unions at locations shown on Drawings.

20 2. Provide either flanges or unions at valves, penetrations through structures and equipment
21 connections. For pipe larger than 2 IN, provide 150 LB socket type PVC flange. For pipe 2
22 IN and less, provide socket type PVC union with O-rings compatible with fluid carried in
23 pipe.

24 3. Flanges shall be Schedule 80, slip ring (van-stone) with a metal retaining ring, solvent weld
25 type and rated for 150 psi.

26 4. Use flat, full faced gaskets at flanged connections with gasket material suitable for the
27 carried fluid. Furnish heavy hex head bolts, each with one heavy hex nut, ASTM F593
28 Type 316 stainless steel.

29 5. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other
30 flanges.

31 F. Installation:

32 1. Field threading PVC will not be permitted. Perform required threaded connections or
33 attachments by the use of factory molded socket by threaded adapters.

34 a. Female adapters are not acceptable.

35 2. Employ installation and pipe support practices and solvent welding all in compliance to the
36 manufacturer's printed recommendation. Continuously support PVC piping at liquid
37 operating temperatures in excess of 100 DegF. For vertical piping, band the pipe at intervals
38 to rigidly support load of twice vertical load. Support riser clamps on spring hangers. Do not
39 clamp PVC tightly or restrict movement for expansion and contraction.

40 **2.3 PRESSURE PIPING – SCHEDULE 40**

41 A. General: Provide Schedule 40 pipe with Schedule 40 fittings and appurtenances at locations
42 shown on drawings. Furnish materials in full compliance to the following material
43 specifications:

44 1. Manufacture pipe, fittings, and appurtenances from polyvinyl chloride (PVC) compound
45 which meets the requirements of Type 1, Grade 1 Polyvinyl Chloride as outlined in ASTM
46 01784.

47 2. Manufacture pipe, fittings, and valves from materials that have been tested and approved for
48 conveying potable water by the National Sanitation Foundation (NSF).

49 B. Pipe: Furnish pipe meeting requirements of ASTM 01785. Pipe to be solvent welded.

- 1 C. Fittings: Provide ASTM 02466 socket type fittings having the same pressure and temperature
2 rating as the pipe.

3 **2.4 PRESSURE PIPING – AWWA C900**

- 4 A. Acceptable manufacturers, subject to compliance with specifications:
5 1. J-M Pipe.
6 2. Certainted.
7 3. North American Pipe.
8 4. Can-Tex.
- 9 B. General: Provide pipe, fittings, and appurtenances to locations shown on Drawings. Furnish
10 materials in full compliance to following material specifications:
11 1. 4 – 12 IN: AWWA C900 with a pressure class of 200 psi as per Table 2, AWWA C900
12 2. Materials and Basis of Design
13 a. Class 12454-A or Class 12454-B virgin compounds as defined in ASTM 1784.
14 b. Hydrostatic design basis rating of 4,000 psi for water at 73.4 F.
15 c. ANSI-NSF 61 certified.
16 d. Cast iron outside diameter, suitable for use as a pressure conduit.
17 e. Wall thickness and bell conforming to ASTM-D3139.
- 18 3. Fittings
19 a. AWWA C 900 Pipe
20 1) AWWA C900 compliant
- 21 4. Joints
22 a. All buried pipe shall have restrained joints.
23 b. Acceptable Joint Configurations
24 1) Mechanical restrained joints with restraint incorporated into the follower of gland.
25 a) Mechanism consisting of a plurality of individual gripping surfaces to
26 maximize restraint capacity.
27 b) Gland - Ductile iron
28 2) Restraint Joint Harness
29 a) Joint harness designed to resist pullout at joints due to internal pipe pressures.
30 b) Mechanism consisting of a plurality of individual gripping surfaces to
31 maximize restraint capacity.
32 c) Harness components - Ductile iron.
33 d) Bolts and actuating screws – stainless steel.
34 e) EBAA Iron Series 1600, or equal.

35 **2.5 PVC DRAINAGE PIPING**

- 36 A. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by
37 the manufacturer.
38 1. Provide for a maximum deflection of not more than 3 percent.
- 39 B. Deflection: After backfilling, each section of pipe shall be checked for deflection by pulling a
40 mandrel through the pipe. Pipe with deflection exceeding 5 percent of the inside diameter shall
41 have backfill removed and replaced to provide a deflection of less than 5 percent. Any repaired
42 pipe shall be retested.

43 **2.6 PVC TUBING**

- 44 A. General: Provide nylon tubing with fittings and appurtenances as shown on Drawings.
- 45 B. Materials: Furnish clear outer braided tubing with braid outside the walls. Have tubing
46 manufactured of nylon with working temperatures from 5 to 180 DegF. Design tubing with a
47 minimum safety factor of 4 to 1 ratio of burst pressure to working pressure at maximum
48 temperature. Provide tubing with working pressure of 75 psi at 180 DegF.
49 1. Ensure that tubing is self-extinguishing and fire resistant.

- 1 C. Fittings: Install tubing with fittings and connectors compatible with fluid carried in tube. Use
- 2 barbed type adapters with stainless steel clamps. Provide fittings capable of withstanding
- 3 temperatures from a -70 to 250 DegF. Ensure fittings have the same pressure and temperature
- 4 rating as the tubing.

5 **PART 3 - EXECUTION**

6 **3.1 IDENTIFICATION**

- 7 A. Identify each length of pipe clearly at intervals of 5 FT or less. Include manufacturer's name and
- 8 trademark. Nominal size of pipe, appurtenant information regarding polymer cell classification
- 9 and critical identifications regarding performance specifications, and "NSF" approvals when
- 10 applicable.

11 **3.2 INSTALLATION**

- 12 A. Allow no external loads from valves, structures, or other equipment to be supported or absorbed
- 13 by PVC pipe.

14 **3.3 FIELD QUALITY CONTROL**

- 15 A. Test piping systems in accordance with Section 15060.

16 **3.4 DISINFECTION**

- 17 A. For potable water mains, observe disinfection methods described in Section 01733.

18 **END OF SECTION**

- 1 2. Installation instructions for expansion bellows.
- 2 3. Fabrication details and welding procedure specifications for all work to be done under this
- 3 Section.

4 **PART 2 - PRODUCTS**

5 **2.1 ACCEPTABLE MANUFACTURERS**

- 6 A. Compression Fittings:
 - 7 1. Products as manufactured by Imperial, Swagelok, or others, and which meet these
 - 8 Specifications, will be accepted.
- 9 B. Expansion Joints (Air Piping):
 - 10 1. Products as manufactured by Anaconda, Pathway, or others, and which meet these
 - 11 Specifications, will be accepted.

12 **2.2 MATERIALS**

- 13 A. Tubing: ASTM A269.
 - 14 1. Filler material: Extra low carbon (ELC) with 0.03 percent maximum carbon.
- 15 B. Pipe:
 - 16 1. ASTM A312, Grade TP304L, unless otherwise specified or shown on the drawings.
- 17 C. Pipe Fittings:
 - 18 1. ASTM B403, Grade WP304L, Class W, schedule and material to match connected piping.
 - 19 Tees shall have no welds in the throat area and the crotch shall be reinforced with long
 - 20 radius design to eliminate sharp corners.
 - 21 2. ASTM A182, Grade F304L, for forged commercial welded branch fittings with butt welded
 - 22 outlet. Schedule and material to match connecting piping. No repair welding shall be
 - 23 performed.
- 24 D. Flanges:
 - 25 1. Flat faced.
 - 26 2. Welding neck or slip on type.
 - 27 3. ASTM A182, Grade F304 for forged stainless steel.
 - 28 4. ASTM 240, Type 304L, welded grade for lap joint flange with stub end conforming to
 - 29 ASME B16.9.
 - 30 5. Schedule and material to match material of piping.
- 31 E. Nuts, Bolts and Washers:
 - 32 1. ASTM A193, Type 304, Grade B8M.
 - 33 2. Two nuts provided for 1 IN DIA bolt applications and larger
- 34 F. Expansion Joints:
 - 35 1. Bellows: Series 300 Stainless steel.
 - 36 2. Liner: Series 300 Stainless steel.
 - 37 3. Flanges: Steel.
 - 38 4. Control Tie-Rods: Steel.
- 39 G. Compression Sleeve Couplings:
 - 40 1. Per Section 15060 except 316 stainless steel construction
- 41 H. Insulating Flange Sets:
 - 42 1. 1/16 IN thick plastic.
 - 43 2. Full length bolt sleeves.
 - 44 3. 1/8 IN thick insulating washers and flat washers for each flange bolt
- 45 I. Gasket Material:
 - 46 1. Full faced, 1/8 IN thick EPDM.

1 2. Temperature rating of 250 degF.

2 J. Grooved Joints:

3 1. AWWA C606.

4 **2.3 FABRICATION**

5 A. All tube, piping, fitting product to be immersion pickled subsequent to manufacturing and
6 fabrication operations and prior to shipping.

- 7 1. Pickling solution of 6-10 percent nitric acid and 3-4 percent hydrofluoric acid.
8 2. Temperature and exact concentrations to be such only a modest etch is produced but all
9 oxidation and ferrous contamination is removed from metal surface.
10 3. All pickling solution residues are to be neutralized after pickling.

11 B. Diameter tolerance and wall thickness tolerance are to conform to ASTM A530.

12 C. Joints.

- 13 1. Shop welded circumferential butt weld joints.
14 2. ANSI B16.1, Class 150.
15 3. AWWA C606.

16 D. Expansion Joints:

- 17 1. Fabricate for 150 psi internal pressure or equal to the piping system test pressure, which
18 ever is greater, and 250 DegF operation.
19 2. Ensure aerial travel in expansion joints of 3.1 IN minimum for 15,000 cycles or 5.2 IN for
20 1000 cycles.
21 3. Furnish each assembly with minimum four control tie rods.
22 4. Fabricate with 125 LB flanged end connections.

23 **PART 3 - EXECUTION**

24 **3.1 EXAMINATION**

25 A. Prior to installation, inspect and verify condition of piping and appurtenances. Installation
26 constitutes installer's acceptance of condition for satisfactory installation.

27 **3.2 PREPARATION**

- 28 A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.
29 B. Ensure ends of pipe to be fitted with flanges have all protrusions ground flush.
30 C. Passivate inside and out in accordance with ASTM A967.
31 D. Electropolish the outer surface of all stainless steel components until a homogenous, polished
32 appearance is attained.
33 1. All forming, machining, heat treating, pickling, and passivation shall be accomplished prior
34 to electropolishing.
35 2. Electropolished surfaces shall have uniform appearance and shall show no imperfections
36 such as pitting, etch streaks, burn marks, or staining.

37 **3.3 INSTALLATION**

38 A. Ensure all pipe cutting, threading and jointing conforms to requirements of ANSI B31.1.
39 Lubricate all pipe threads with Teflon tape.

40 B. Welding:

- 41 1. Provide welds sound and free from embedded scale or slag, and tensile strength at weld not
42 less than pipe.
43 2. Perform butt welds only with an inert gas shielded process.

3. Adequate inert gas protection is to be provided to the top and under or backside of the weld to protect from atmospheric contamination.
4. Filler metal is to be applied to all manually-performed welds appropriate for the base material being welded.
5. Only inert gas shielded welding processes are to be used for spool fabrication.
6. Provide butt welds with 100 percent penetration to the interior or back side of the weld joint.
7. Weld reinforcement on both sides of the weld are to be smooth, uniform and no more than 1/16 IN in height.
8. All welds to be passivated.

C. Joining Method - Flanges:

1. Leave 1/8 to 3/8 IN flange bolts projecting beyond face of nut after tightening. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, equipment, and other systems. Tighten bolts evenly around pipe until following range of torques are achieved:

Bolt Size, IN	Ranges of Torque, FT-LB
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1-1/4	90 - 120

D. Compression Sleeve Couplings:

1. Install coupling to allow space of not less than 1/4 IN but no more than 1 IN.
2. Provide harnessed joint unless otherwise shown on Drawings or specified. Use joint harness arrangements detailed in AWWA M11 or as indicated on Drawings.

E. Expansion Joints:

1. Install in accordance with manufacturer's instructions.
2. Install when outside temperature is between 50 to 70 Degf.

F. Any cutting, drilling, etc. that heats the piping must be passivated before placing into service.

3.4 FIELD QUALITY CONTROL

- A. Test piping systems in accordance with Section 15060.

END OF SECTION

1 2002/11/25

2 **SECTION 15090**
3 **PIPE SUPPORT SYSTEMS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Pipe support and anchor systems.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 09905 - Painting and Protective Coatings.

12 **1.2 QUALITY ASSURANCE**

- 13 A. Referenced Standards:
14 1. American National Standards Institute (ANSI):
15 a. B31.1, Power Piping.
16 2. ASTM International (ASTM):
17 a. A36, Standard Specification for Carbon Structural Steel.
18 b. A510, Standard Specification for General Requirements for Wire Rods and Coarse
19 Round Wire, Carbon Steel.
20 c. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
21 d. A576, Standard Specification for Steel Bars, Hot-Wrought, Special Quality.
22 3. American Welding Society (AWS):
23 a. D1.1, Structural Welding Code Steel.
24 4. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
25 a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
26 b. SP-69, Pipe Hangers and Supports - Selection and Application.

27 **1.3 SUBMITTALS**

- 28 A. Shop Drawings:
29 1. See Section 01340.
30 2. Product technical data including:
31 a. Acknowledgement that products submitted meet requirements of standards referenced.
32 b. Manufacturer's installation instructions.
33 c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe
34 support system.
35 d. Scale drawings showing guides, hangers, supports, anchors, structural members and
36 appurtenances to describe the pipe support system.

37 **PART 2 - PRODUCTS**

38 **2.1 MANUFACTURED UNITS**

- 39 A. Where indicated on Drawings and specified herein, provide stainless steel materials meeting the
40 following.
41 1. Minimum yield strength of 30,000 psi and minimum tensile strength of 75,000 psi.
42 a. Bars, shapes: ASTM A276, Type 304.
43 b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 304 or 316.
44 c. Strip, plate and flat bars: ASTM A666, Type 304 or 316, Grade A.

- 1 d. Bolts and nuts: ASTM F593, Type 303, 304 or 316.
 2 2. Minimum yield strength of 25,000 psi and minimum tensile strength of 70,000 psi.
 3 a. Strip, plate and flat bar for welded connections, ASTM A666, type 304L or 316L.
- 4 B. Structural Framing Channel
 5 1. Unistrut, Aickenstrut, or equal.
 6 2. 1 5/8 inch standard shapes with standard hardware. Hardware materials as indicated on
 7 Drawings.
 8 3. Fiberglass reinforced plastic or galvanized steel as indicated on Drawings. See Pipe
 9 Support Notes on Drawings
- 10 C. Hanger Rods: For use in all areas except hazardous locations. See Pipe Support Notes on
 11 Drawings for designation of hazardous locations.
 12 1. Material: Steel.
 13 a. ASTM A575, Grade 1020.
 14 b. Minimum allowable tensile stress of 12,000 psi at 650 DegF per MSS-SP-58.
 15 2. Continuously threaded.
 16 3. Electro-galvanized or cadmium plated after threads are cut.
 17 4. Load limit for steel hangers - modify based on strength of rod if alternate materials are used:
 18

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

- 19
 20 D. Hanger Rods: For use in hazardous locations.
 21 1. Material: Stainless steel.
 22 2. Load limit-- modify load limit for steel hangers based on strength of rod. Obtain from
 23 manufacturer.
- 24 E. Hangers:
 25 1. Hangers for use other than directly on copper pipe: Cadmium plated or galvanized unless
 26 noted otherwise on Drawings.
 27 2. Hangers in hazardous locations: stainless steel.
 28 3. Hanger types: As shown on Drawings.
- 29 F. Concrete Inserts for Hanger Rods:
 30 1. Continuous slots: Unistrut #P1000.
 31 2. Individual inserts: ANVIL Figure 281.
 32 3. Self-drilling expansion anchors: Phillips flush-end or snap-off end type.
 33 4. Epoxy: Hilti HY150.
- 34 G. Beam Clamps for Hanger Rods:
 35 1. Materials: As indicated on Drawings.
 36 2. Heavy duty.
 37 3. ANVIL Figure 134.
- 38 H. Trapeze Hangers for Suspended Piping:
 39 1. Galvanized steel unless indicated otherwise on Drawings.
 40 2. Stainless Steel in hazardous locations.
 41 3. Angles, channels, or other structural shapes.
 42 4. Curved roller surfaces at support point corresponding with type of hanger required.
- 43 I. Vertical Pipe Supports:
 44 1. At base of riser: Base angle pipe fittings.

- 1 2. On vertical risers: Locate at no greater intervals that ½ of the Maximum Span indicated in
2 paragraph 2.2.
- 3 J. Expanding Pipe Supports:
4 1. Spring hanger type.
5 2. MSS SP-58.
- 6 K. Pipe Support Saddle:
7 1. For pipe located 3 FT or less from floor elevation, except as otherwise indicated on
8 Drawings.
9 2. ANVIL Figure 264.
- 10 L. Pipe Support Risers:
11 1. Schedule 40 pipe.
12 2. Galvanized.
13 3. Type 316 Stainless Steel in hazardous locations.
14 4. As recommended by saddle manufacturer.
- 15 M. Pipe Support Base Plate:
16 1. 4 IN larger than support.
17 2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.
18 3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.
19 4. Collar welded to floor plate.
20 5. Edges ground smooth.
21 6. Assembly hot dipped galvanized after fabrication.
22 7. Type 316 Stainless Steel in hazardous locations.
- 23 N. Pipe Covering Protection Saddle:
24 1. For insulated pipe at point of support.
25 2. ANVIL Figure 167, Type B.
- 26 O. Wall Brackets:
27 1. Materials: As indicated on Drawings.
28 2. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated
29 on the Drawings.
30 3. ANVIL Figure 199.
- 31 P. Pipe Anchors:
32 1. For locations shown on the Drawings.
33 2. 1/4 IN steel plate construction.
34 3. Hot dipped galvanized after fabrication.
35 4. Designed to prevent movement of pipe at point of attachment.
- 36 Q. Pipe Guides:
37 1. For locations on both sides on each expansion joint or loop.
38 2. To ensure proper alignment of expanding or contracting pipe.
39 3. ANVIL Figure 256.
- 40 R. Sway Strut:
41 1. ANVIL Figure 640.
- 42 S. Substitutions:
43 1. Submit requests for substitutions in accordance with Specification Section 01640.

44 2.2 DESIGN REQUIREMENTS

- 45 A. Contractor is responsible for selection of pipe supports, design of supports, and placement.
46 1. Support configurations shown on Drawings and included in this Section may be used.
47 2. Submit alternate configurations, materials, manufactured units, etc. if those shown and
48 specified do not meet Contractors requirements.
49 3. Employ services of a registered professional to design support systems where warranted.

- 1 a. Bell and spigot piping:
 - 2 1) At least one hanger.
 - 3 2) Applied at bell.
- 4 b. Mechanical coupling joints:
 - 5 1) Place hanger within 2 FT of each side of fittings to keep pipes in alignment.
- 6 5. Space supports for vertical pipe risers at no greater than ½ the maximum span indicated for
- 7 horizontal piping.
- 8 6. Space supports for soil and waste pipe and other piping systems not included above every 5
- 9 FT.
- 10 7. Provide continuous support for nylon tubing.

11 **PART 3 - EXECUTION**

12 **3.1 INSTALLATION**

- 13 A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable
- 14 constraints to correct the condition.
 - 15 1. Included in this requirement are movements from:
 - 16 a. Trap discharge.
 - 17 b. Water hammer.
 - 18 c. Similar internal forces.
- 19 B. Weld Supports:
 - 20 1. AWS D1.1.
 - 21 2. Weld anchors to pipe in accordance with ANSI B31.3.
- 22 C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and
- 23 with maintenance or disassembly of equipment.
- 24 D. Inspect hangers for:
 - 25 1. Design offset.
 - 26 2. Adequacy of clearance for piping and supports in the hot and cold positions.
 - 27 3. Guides to permit movement without binding.
 - 28 4. Adequacy of anchors.
- 29 E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.
- 30 F. Install individual or continuous slot concrete inserts for use with hangers for piping and
- 31 equipment.
 - 32 1. Install concrete inserts as concrete forms are installed.
- 33 G. Welding:
 - 34 1. Welding rods: ASTM and AWS standards.
 - 35 2. Integral attachments:
 - 36 a. Include welded-on ears, shoes, plates and angle clips.
 - 37 b. Ensure material for integral attachments is of good weldable quality.
 - 38 3. Preheating, welding and postheat treating: ANSI B31.3, Chapter V.
 - 39 4. Passivate all welding and cutting of stainless steel.
- 40 H. Field Painting:
 - 41 1. Comply with Section 09905.

42

END OF SECTION

1 2002/09/16

2 **SECTION 15100**
3 **VALVES - BASIC REQUIREMENTS**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Valving, actuators, and valving appurtenances.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 09905 - Painting and Protective Coatings.
12 4. Section 11005 - Equipment: Basic Requirements.
13 5. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

14 **1.2 QUALITY ASSURANCE**

- 15 A. Referenced Standards:
16 1. American National Standards Institute (ANSI):
17 a. B1.20.1, Pipe Threads, General Purpose.
18 b. B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
19 c. B16.34, Valves-Flanged, Threaded and Welding End.
20 2. American Water Works Association (AWWA):
21 a. C111, Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
22 b. C207, Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
23 c. C500, Gate Valves for Water and Sewerage Systems.
24 d. C504, Rubber-Seated Butterfly Valves.
25 e. C507, Ball Valves, 6 IN through 48 IN (150 MM through 1200 MM).
26 f. C509, Resilient-Seated Gate Valves 3 through 12 NPS, for Water and Sewage Systems.
27 g. C540, Power-Actuating Devices for Valves and Sluice Gates.
28 h. C550, Protective Epoxy Interior Coatings for Valves and Hydrants.
29 i. C606, Grooved and Shouldered Joints.
30 j. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural
31 Load.
32 3. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.(MSS).
33 4. National Electrical Manufacturers Association (NEMA):
34 a. MG 1, Motors and Generators.
35 b. ICS 6, Enclosures for Industrial Controls and Systems.

36 **1.3 DEFINITIONS**

- 37 A. The following are definitions of abbreviations used in this section or one of the individual valve
38 sections:
39 1. WWP: Water working pressure.
40 2. See Section 15060 for pipe designations.

41 **1.4 SUBMITTALS**

- 42 A. Shop Drawings:
43 1. See Section 01340.
44 2. Product technical data including:
45 a. Acknowledgement that products submitted meet requirements of standards referenced.
46 b. Manufacturer's installation instructions.

- 1 c. Valve pressure and temperature rating.
- 2 d. Valve material of construction.
- 3 e. Special linings.
- 4 f. Valve dimensions and weight.
- 5 g. Valve flow coefficient.
- 6 h. Wiring and control diagrams for electric or cylinder actuators.
- 7 3. Complete valve schedule including service, size, valve type and materials in tabular form.
- 8 4. Test reports.
- 9 B. Operation and Maintenance Manuals:
- 10 1. See Section 01340.

11 **PART 2 - PRODUCTS**

12 **2.1 ACCEPTABLE MANUFACTURERS**

- 13 A. Refer to individual valve specification sections.
- 14 B. Manual Actuators:
 - 15 1. Limitorque.
 - 16 2. EIM Co.
 - 17 3. Dezurik.
 - 18 4. Or approved equal.
- 19 C. Electric Actuators:
 - 20 1. Limitorque, Model SMC with T-series actuator.
 - 21 2. EIM Co., Model 2000/MG.
 - 22 3. AUMA, Models SA07.1 through SA48.1.
 - 23 4. Rotork, Model A Range with Type IW or IWS actuator.
 - 24 5. No other manufacturers will be considered.
- 25 D. Pneumatic Actuators:
 - 26 1. Kinetrol.
 - 27 2. Ktork.
 - 28 3. Tyco – Morin.
 - 29 4. Or approved equal.
- 30 E. Submit requests for substitution in accordance with Specification Section 01640.

31 **2.2 MATERIALS**

- 32 A. Refer to individual valve specification sections.
- 33 B. ANSI/NSF 61 approved.

34 **2.3 VALVE ACTUATORS**

- 35 A. Valve Actuators - General:
 - 36 1. Provide actuators as shown on Drawings or specified.
 - 37 2. Counter clockwise opening as viewed from the top.
 - 38 3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
 - 39 4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum
 - 40 pressure rating of the valve provided and withstand without damage a pull of 200 LB on
 - 41 handwheel or chainwheel or 300 foot-pounds torque on the operating nut.
 - 42 5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in
 - 43 vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
 - 44 6. Extension Stem:
 - 45 a. Install where shown or specified.

- 1 b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator
- 2 shaft.
- 3 c. Pin all stem connections.
- 4 d. Center in valve box or grating opening band with guide bushing.
- 5 B. Buried Valve Actuators:
- 6 1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN
- 7 minimum thickness, and identifying cast iron cover.
- 8 2. Box base to enclose buried valve gear box or bonnet.
- 9 3. Provide 2 IN standard actuator nuts complying with Section 3.16 of AWWA C500.
- 10 4. Provide at least two teehandle keys for actuator nuts, with 5 FT extension between key and
- 11 handle.
- 12 5. Extension Stem:
- 13 a. Provide for buried valves greater than 4 FT below finish grade.
- 14 b. Extend to within 6 IN of finish grade.
- 15 6. Provide concrete pad encasement of valve box for all buried valves unless shown otherwise.
- 16 C. Exposed Valve Manual Actuators:
- 17 1. Provide for all exposed valves not having electric or cylinder actuators.
- 18 2. Provide handwheels for gate and globe valves.
- 19 a. Size handwheels for valves in accordance with AWWA C500.
- 20 3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and
- 21 smaller.
- 22 a. Lever actuators for butterfly valves shall have a minimum of 5 intermediate lock
- 23 positions between full open and full close.
- 24 b. Provide at least two levers for each type and size of valve furnished.
- 25 4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and
- 26 larger.
- 27 5. Provide gearing for gate valves 20 IN and larger in accordance with AWWA C500.
- 28 6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
- 29 7. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.
- 30 a. Stainless steel chain looped to within 3 FT of finish floor.
- 31 b. Equip chain wheels with chain guides to permit rapid operation with reasonable side
- 32 pull without "gagging" the wheel.
- 33 8. Provide cast iron floor stands where shown on Drawings. Stands to be furnished by valve
- 34 manufacturer with actuator.
- 35 a. Stand or actuator to include thrust bearings for valve operation and weight of
- 36 accessories.
- 37 9. Proximity type limit switches shall be provided for manual valves to register the open and
- 38 closed position.
- 39 D. Submerged Actuators:
- 40 1. The valve actuator shall be mounted on top of an extension bonnet, 3 FT above any adjacent
- 41 personnel access.
- 42 2. The valve and bonnet connection shall be flanged and watertight.
- 43 3. Provide a top brace support for the bonnet. Mount the brace 6 IN below the top of the wall
- 44 as shown.
- 45 4. Materials:
- 46 a. Extension bonnet: Cast iron ASTM A126 or steel.
- 47 b. Brace and anchor bolts: Type 304 stainless steel.
- 48 E. Electric Actuators (480 V, 3 phase):
- 49 1. General:
- 50 a. Self contained including motor, gearing, torque switch, limit switches and cast housing.
- 51 b. Electrical enclosure: NEMA 4.
- 52 c. Factory assembled requiring only field connection of power and control wires.
- 53 d. Comply with Section 11005.

- 1 e. Electric actuators for buried valves shall be mounted at grade in vault.
- 2 2. Motors:
- 3 a. Produce 1.5 times the required torque.
- 4 b. Sized for two complete open-close cycles without overheating.
- 5 c. One fully closed to fully open cycle to occur within 60 SEC.
- 6 d. Class F insulation.
- 7 e. Operate at plus or minus 10 percent voltage.
- 8 f. 480 Volt, three phase, 60 Hz.
- 9 g. Provide thermal cutout switch and internal heater for actuator enclosure.
- 10 h. Control wiring as shown on Drawing control diagrams.
- 11 3. Actuator Mounted Pushbutton Station:
- 12 a. Enclosure: NEMA 4 stainless steel.
- 13 b. Control relays shall include:
- 14 1) Open relay.
- 15 2) Closed relay.
- 16 3) PLC interface relay.
- 17 c. Push-to-test indicating lights shall include:
- 18 1) Open.
- 19 2) Closed.
- 20 3) Remote.
- 21 d. Selector switches shall include:
- 22 1) Local-Remote.
- 23 2) Open-Close.
- 24 e. Space heater for enclosure.
- 25 f. Control wiring as shown on one-line diagrams.
- 26 g. Wire all components to an internal terminal strip and include mounted wiring diagram
- 27 inside enclosure.
- 28 h. Pushbutton control may be located on the valve.
- 29 4. Spare parts:
- 30 a. Provide spare control card for each size and type of actuator.
- 31 F. Pneumatic Actuators:
- 32 1. Actuators:
- 33 a. Vane-type quarter-turn pneumatic actuators.
- 34 b. Provide all linkage and appurtenances required to mount, support, and isolate the
- 35 actuator to the valve and air supply.
- 36 c. Double acting and operates on 60-100 PSI compressed air supply.
- 37 d. Rated for 150 psig.
- 38 e. Any hoses between control and actuator to be oil resistant and arranged to avoid sharp
- 39 bending from hose weight.
- 40 f. Equip with inlet air filter(s) or strainer(s).
- 41 g. Position actuator above or to side of valve.
- 42 h. Extension tube, where required to facilitate installation or where shown on the
- 43 drawings, shall be Type 316 stainless steel and designed to withstand twice the rated
- 44 output torque of the actuator.
- 45 2. Controls: provide pre-piped, pre-wired control:
- 46 a. Pipe with corrosion-resistant metal equal to Type 316 stainless steel.
- 47 b. Provide four-way, two-position, 110 V solenoid valve with Type 316 stainless steel
- 48 body in weatherproof enclosure.
- 49 c. Provide open-closed signal limit switches.
- 50 d. Speed control valves to independently control opening and closing speed between 10
- 51 and 60 SEC.
- 52 e. Provide means of manually initiating valve actuation.
- 53 f. For modulating valves provide position transmitter, 4-20 mA including signal converter
- 54 if required.
- 55 g. For open/close valves, provide limit switches to indicate open/close position.

1 **2.4 FABRICATION**

- 2 A. End Connections:
- 3 1. Provide the type of end connections for valves as required in the Piping Schedules presented
- 4 in Section 15060 or as shown on the Drawings.
- 5 2. Comply with the following standards:
- 6 a. Threaded: ANSI B1.20.1.
- 7 b. Flanged: ANSI B16.1 Class 125 unless otherwise noted or AWWA C207.
- 8 c. Bell and spigot or mechanical (gland) type: AWWA C111.
- 9 d. Grooved: Rigid joints per Table 5 of AWWA C606.
- 10 B. Refer to individual valve sections for specifications of each type of valve on Project.
- 11 C. Nuts, Bolts, and Washers:
- 12 D. Wetted or internal to be bronze or stainless steel. Exposed to be zinc, cadmium plated, or match
- 13 valve body material.
- 14 E. Epoxy Interior Coating:
- 15 1. Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.
- 16 2. ANSI/NSF 61 approved.
- 17 F. All valves of the same type shall be from the same manufacturer.

18 **PART 3 - EXECUTION**

19 **3.1 INSTALLATION**

- 20 A. Install products in accordance with manufacturer's instructions.
- 21 B. Painting Requirements:
- 22 1. Comply with Section 09905 for painting and protective coatings.
- 23 C. Setting Buried Valves:
- 24 1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
- 25 2. Set valves and valve boxes plumb.
- 26 3. Place valve boxes directly over valves with top of box being brought to surface of finished
- 27 grade.
- 28 4. Install in closed position.
- 29 5. Place valve on firm footing in trench to prevent settling and excessive strain on connection
- 30 to pipe.
- 31 6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of
- 32 box.
- 33 D. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads
- 34 being transferred to valve and valve loads being transferred to the piping.
- 35 E. For grooved coupling valves, install rigid type couplings or provide separate support to prevent
- 36 rotation of valve from installed position.
- 37 F. Install electric actuators above or horizontally adjacent to valve and gear box to optimize access
- 38 to controls and external handwheel.
- 39 G. For threaded valves, provide union on one side within 2 FT of valve to allow valve removal.
- 40 H. Install valves accessible for operation, inspection, and maintenance.
- 41 I. A molybdenum disulfide anti-seize compound shall be applied to all threads in mechanical
- 42 connections such as bolts, studs, screws, etc. unless otherwise noted.

43 **3.2 ADJUSTING**

1 A. Adjustment valves, actuators and appurtenant equipment to comply with Section 01650. Operate
2 valve, open and close at system pressures.

3 **3.3 SCHEDULES**

- 4 A. Refer to Schedule for valves 8 IN and larger.
5 1. Actuated and specialty valves less than 8 IN are listed in the Schedule.
6 2. Manual valves less than 8 IN are not scheduled, but type and size are defined on Drawings
7 in plan, section, or schematic.

VALVE SCHEDULE

1

Equipment Tag	Supplier	Size in	Valve Class	Actuator	Remarks	Type of Installation	Working Pressure (psi)
SERIES							
FCV-9863	GC	14	150-FL	Pneumatic	Raw water to clarifier	Exposed	30
CV-9897	GC	14	150B-FL	Manual	Raw water to clarifier	Exposed	30
BFV-7696A	GC	8	150-FL	Manual	Strainer isolation	Exposed	30
BFV-7696B	GC	8	150-FL	Manual	Strainer isolation	Exposed	30
BFV-7697A	GC	8	150-FL	Manual	Strainer isolation	Exposed	30
BFV-7697B	GC	8	150-FL	Manual	Strainer isolation	Exposed	30
FCV-3463-1	GC	10	150-FL	Pneumatic	Feed water to membrane tank	Exposed	30
CV-3497-1	GC	10	150B-FL	Manual	Feed water to membrane tank	Exposed	30
BFV-7196	GC	18	150-MJ	Manual	Finished water	Buried	5
FV-3876	GC	6	150-FL	Electric	Reject water to clarifier	Vault	25
FV-3877A	GC	6	150-FL	Electric	Reject water to backwash sump	Vault	25
FV-3877B	GC	6	150-FL	Electric	Reject water to lagoon	Vault	25
BFV-3883	GC	6	150-MJ	Manual	Reject water to bw sump/lagoon	Buried	25
BFV-3896	GC	6	150-MJ	Manual	Reject water to clarifier	Buried	25
BFV-3897A	GC	8	150-MJ	Manual	Reject water to backwash sump	Buried	25
BFV-3897B	GC	4	150-MJ	Manual	Reject water from sump to clarifier	Buried	25
BFV-3897C	GC	6	150-MJ	Manual	Reject water to lagoon	Buried	25
PRV-9482	GC	6	250-FL	Manual	Membrane Bldg water supply	Exposed	125
BFP-9496	GC	1	150-FL	Manual	Potable water for strainer backwash	Exposed	125
BFP-9697	GC	2	150-FL	Manual	Potable water for backpulse tank	Exposed	125
CV-7685	GC	10	150B-FL	Manual	After RW pump	Exposed	30

Equipment Tag	Supplier	Size in	Valve Class	Actuator	Remarks	Type of Installation	Working Pressure (psi)
BFV-7680	GC	10	150B-FL	Manual	RW pump isolation	Exposed	30

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2 GC = General Contractor

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END OF SECTION

2 **SECTION 15103**
3 **BUTTERFLY VALVES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Butterfly valves.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
12 4. Section 15100 - Valves: Basic Requirements.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:
15 1. American National Standards Institute (ANSI):
16 a. B16.1, Pipe Flanges and Flanged Fittings.
17 b. B16.5, Pipe Flanges and Flanged Fittings.
18 2. ASTM International (ASTM):
19 a. A48, Standard Specifications for Gray Iron Castings.
20 b. A126, Gray Iron Castings for Valves, Flanges and Pipe Fittings.
21 c. A276, Standard Specification for Stainless Steel Bars and Shapes.
22 d. A436, Austenitic, Gray Iron Castings.
23 e. A536, Standard Specification for Ductile Iron Castings.
24 3. American Water Works Association (AWWA):
25 a. C504, Rubber Seated Butterfly Valves.
26 4. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
27 a. SP-67, Butterfly Valves.

28 **1.3 SUBMITTALS**

- 29 A. Shop Drawings:
30 1. See Section 15100.
31 2. For valves 8 IN and larger, furnish "Affidavit of Compliance" with Owner in accordance
32 with AWWA C504.
- 33 B. Operation and Maintenance Manuals:
34 1. See Section 01340.

35 **PART 2 - PRODUCTS**

36 **2.1 ACCEPTABLE MANUFACTURERS**

- 37 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable
38 articles below are acceptable:
- 39 B. Submit requests for substitution in accordance with Specification Section 01640.

40 **2.2 BUTTERFLY VALVES (AWWA C504)**

- 41 A. Comply with AWWA C504.

- 1 B. Acceptable manufacturers, subject to compliance with specifications:
2 1. Henry Pratt Company, Groundhog (3 IN-72 IN), 2FII (3 IN – 20 IN)
3 2. DeZurik, BAW.
4 3. Mueller Company, Lineseal III.
5 4. CMB Industries, K-Flo Models 504 and 47.
6 5. Tyco – Keystone.
7 6. Or approved equal.
- 8 C. Materials:
9 1. Valve bodies:
10 a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
11 2. Valve shafts:
12 a. Stainless steel, 18-8, Type 304 or 316.
13 3. Valve discs:
14 a. Potable and nonpotable water:
15 1) ASTM A536, Grade 65-45-12 ductile iron. or
16 2) Stainless Steel, ASTM A276, Type 304 or Type 316. or
17 b. Air and similar applications: ASTM A48, Class 40 cast iron:
18 4. Valve seats:
19 a. Potable and nonpotable water below 150 DegF:
20 1) Natural rubber.
21 b. Potable and nonpotable water and wastewater and air below 180 DegF:
22 1) Buna-N.
23 c. Heating water and air 180 to 250 DegF.
24 1) EPDM.
25 5. Mating surfaces:
26 a. Valves less than 30 IN: ASTM A276, 18-8, stainless steel or bronze.
27 b. Valves 30 IN and larger: ASTM A276, 18-8, stainless steel.
- 28 D. Design Requirements:
29 1. Seat type: Resilient. Comply with AWWA C504.
30 2. Direct Buried valves: 3 IN to 8 IN
31 a. Body type: Short body Mechanical Joint (laying length may vary from AWWA C504).
32 b. Working Pressure: 150 psi (Class 150B per AWWA C504).
33 3. Direct Buried valves: 10 IN and larger
34 a. Body type: Short body mechanical joint (laying length may vary from AWWA C504).
35 b. Working Pressure: See valve schedule.
36 4. Exposed and submerged valves 3 through 8 IN.
37 a. Body type: Short body flange (laying length may vary from AWWA C504).
38 b. Working pressure: 150 psi.
39 5. Exposed and submerged valves 10 IN and larger:
40 a. Body type: Short body flange.
41 b. Working pressure: See valve schedule.
- 42 E. Actuators
43 1. The rated torque capacity for each butterfly valve actuator shall be determined by the valve
44 manufacturer based on a pipe line velocity of 12 FT/SEC and a pipe line working pressure
45 as listed above or shown on the valve schedule in section 15100.

46 2.3 HIGH PERFORMANCE BUTTERFLY VALVES

- 47 A. Design Requirements:
48 1. Flow control valves: Tag No's FCV-7663 and FCV-3463.
49 2. Inlet pressure: 30 psi.
50 3. Flow rate:
51 a. FCV-7663:
52 1) Minimum: 2,430 gpm.
53 2) Average: 2,950 gpm.

- 1 3) Maximum: 3,470 gpm.
- 2 b. FCV-3463:
- 3 1) Minimum: 760 gpm.
- 4 2) Average: 970 gpm.
- 5 3) Maximum: 1,240 gpm.
- 6 4. Actuator: Pneumatic (see Section 15100).
- 7 B. Acceptable manufacturers:
- 8 1. Keystone – K-LOK Higher Performance Butterfly Valve – F312 or F362.
- 9 2. DeZurik – High Performance Butterfly Valve.
- 10 3. Flowseal – Soft Seat High Performance Butterfly Valve.
- 11 4. Jamesbury – Wafersphere High Performance Butterfly Valve.
- 12 5. Fisher – Posiseal.
- 13 6. Masoneilon Dresser – High Performance Butterfly Valve.
- 14 C. Provide ANSI Class VI shutoff.
- 15 D. Materials of construction:
- 16 1. Body and Disc: 316 stainless steel.
- 17 2. Shaft and pins: 17-4PH SS or 316 stainless steel.
- 18 3. Seats and seals:
- 19 a. Water – EPDM or RTFE.
- 20 b. Compressed air – Teflon.
- 21 c. Process air – Viton or RTFE rated for 300 degF minimum or higher if required by
- 22 service.
- 23 4. Backing ring: stainless steel.
- 24 5. Bushings/Bearings: EPDM, RTPE.
- 25 6. Packing: PTFE.
- 26 E. End connection: Lugged valves may be used.
- 27 F. Actuators
- 28 1. The rated torque capacity for each butterfly valve actuator shall be determined by the valve
- 29 manufacturer based on a pipe line velocity of 12 FT/SEC and a pipe line working pressure
- 30 as listed above or shown on the valve schedule in section 15100.

31 **2.4 ACCESSORIES**

- 32 A. Refer to Drawings and/or valve schedule for type of actuators. Furnish actuator integral with
- 33 valve.
- 34 B. Refer to Section 15100 for actuator requirements.

35 **PART 3 - EXECUTION**

36 **3.1 INSTALLATION**

- 37 A. See Section 15100.

38 **3.2 FIELD QUALITY CONTROL**

- 39 A. Provide Manufacturer's Field Services as defined in Section 01650 to provide the following
- 40 services:
- 41 1. Assistance during installation to include observation, guidance, instruction of
- 42 CONTRACTOR's assembly, erection, installation or application procedures.
- 43 2. Inspection, checking, and adjustment as required for equipment to function as warranted
- 44 by manufacturer and necessary to provide written approval of installation.
- 45 3. Revisiting the site as required to correct problems and until installation and operation are
- 46 acceptable to OWNER.

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4. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
5. Assistance during Demonstration Period functional and performance testing, and until product acceptance by the OWNER.
6. Training of OWNER's personnel in the operation and maintenance of respective product as required herein.
 - i. See Section 01650 for duration and scheduling of training sessions required.
 - ii. Training may be specified as either during the Pre-Demonstration Period or Post Demonstration.
7. Completion of Manufacturer's Certificate of Proper Installation as include in Section 01650 with applicable certificates for proper installation and initial, interim, and final test service.
8. Complete Certificate of Successful Start-up as defined in Section 01650.

END OF SECTION

1 2002/01/14

2 **SECTION 15104**
3 **BALL VALVES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Ball valves.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 15100 - Valves: Basic Requirements.

12 **1.2 QUALITY ASSURANCE**

- 13 A. Referenced Standards:
14 1. ASTM International (ASTM):
15 a. A48, Standard Specification for Gray Iron Castings.
16 b. A126, Gray Iron Castings for Valves Flanges, and Pipe Fittings.
17 c. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and
18 Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
19 2. American National Standards Institute (ANSI):
20 a. B16.34, Valves-Flanged, Threaded, and Welding End.
21 3. Federal Specification:
22 a. WW-V-35C.

23 **1.3 SUBMITTALS**

- 24 A. Shop Drawings:
25 1. See Section 15100.
26 2. Test results for AWWA valves.
- 27 B. Operation and Maintenance Manuals:
28 1. See Section 01340.

29 **PART 2 - PRODUCTS**

30 **2.1 ACCEPTABLE MANUFACTURERS**

- 31 A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable
32 articles below are acceptable.
- 33 B. Submit requests for substitution in accordance with Specification Section 01640.

34 **2.2 STAINLESS STEEL BALL VALVES**

- 35 A. Install as isolation valve at all pressure gauges, pump casing drains, and other locations shown
36 on the Drawings.
- 37 B. Minimum working pressure is 800 psi (WOG).
- 38 C. Acceptable manufacturers:
39 1. Apollo Type 76.
40 2. Watts Type S-8100 and S-8000.

- 1 3. Whitey (Swagelock) Series 40.
- 2 4. Parker CPI – 2 way ball valve.
- 3 D. Materials
- 4 1. Body: 316 stainless steel.
- 5 2. Ball: 316 stainless steel ball, polished finish.
- 6 3. Stem: 316 stainless steel.
- 7 4. Seat: Teflon.
- 8 E. Actuator
- 9 1. Provide lever handle for manual actuation.
- 10 2. Provide double acting pneumatic actuator from the manufacturer of the valve if the valve is
- 11 less than 1” in size. If the valve is larger, refer to Section 15100.
- 12 F. End connection:
- 13 1. For 2” or less, use NPT threaded connection.
- 14 2. For larger than 2” and in all caustic applications, use flange end connection.

15 **2.3 METALLIC BALL VALVES 1/4 TO 3 IN DIA**

- 16 A. Comply with Federal Specification WW-V-35C Type II, Class A.
- 17 B. Acceptable Manufacturers:
- 18 1. Apollo.
- 19 2. Jamesbury.
- 20 3. Watts.
- 21 4. Stockham.
- 22 5. Nibco.
- 23 6. Or equal.
- 24 C. Materials:
- 25 1. Body: Bronze.
- 26 2. Stem, stem gland nut: Brass.
- 27 3. Ball: Brass, chrome plated.
- 28 4. Seats, stuffing box ring, and thrust washer: Reinforced Teflon.
- 29 5. Handle: Vinyl coated or zinc- or cadmium-plated steel.
- 30 D. Design Requirements:
- 31 1. Rated for 400 psi and 250 DegF, WOG for threaded end applications and 285 psi WOG and
- 32 150 psi saturated steam service for flanged end applications.
- 33 2. Lever handles showing direction of opening.
- 34 3. Stuffing boxes capable of being repacked under pressure and adjustable for wear.
- 35 4. Stem with reinforced Teflon stuffing box ring and blowout-proof design.
- 36 5. Renewable reinforced Teflon seats.
- 37 6. Ball design which does not allow media contact with stem.
- 38 7. Balancing stop for all applications.
- 39 8. Bodies with mounting pad for applications requiring actuators.
- 40 9. Locking handle on flanged valve.

41 **2.4 PLASTIC BALL VALVES 1/2 TO 4 IN DIA**

- 42 A. Acceptable Manufacturers:
- 43 1. Chemtrol.
- 44 2. Spears.
- 45 3. ASAHI/America.
- 46 4. Chemline.
- 47 5. Or approved equal.
- 48 B. Materials:
- 49 1. Body, stem, ball, handle, end connectors:

- 1 a. PVC ASTM D1784-12454B or CPVC ASTM D1784-23477-B.
- 2 2. Ball Seat: Compatible with the service of the valve.
- 3 3. O-rings: Compatible with the service of the valve.
- 4 C. Design Requirements:
- 5 1. Rated at 150 psi at 75 DegF.
- 6 2. Double or "true union" design.
- 7 3. Blocks both directions, upstream and downstream.
- 8 4. Union nut capable of compensating for seat wear.
- 9 5. Body with mounting pad for actuators where required.
- 10 6. Capable of being disconnected at downstream end under full line pressure.
- 11 7. For all concentrated chemical solutions, the materials of construction must be compatible
- 12 with concentrated chemical solution.

13 **2.5 ACCESSORIES**

- 14 A. Refer to Drawings and valve schedule for type of actuators. Furnish actuator integral with valve.
- 15 B. Refer to Section 15100 for actuator requirements.

16 **2.6 SOURCE QUALITY CONTROL**

- 17 A. Furnish record of test.

18 **PART 3 - EXECUTION**

19 **3.1 INSTALLATION**

- 20 A. See Section 15100.

21 **3.2 FIELD QUALITY CONTROL**

- 22 A. Provide Manufacturer's Field Services as defined in Section 01650 to provide the following
- 23 services:
- 24 1. Assistance during installation to include observation, guidance, instruction of
- 25 CONTRACTOR's assembly, erection, installation or application procedures.
- 26 2. Inspection, checking, and adjustment as required for equipment to function as warranted
- 27 by manufacturer and necessary to provide written approval of installation.
- 28 3. Revisiting the site as required to correct problems and until installation and operation are
- 29 acceptable to OWNER.
- 30 4. Resolution of assembly or installation problems attributable to, or associated with,
- 31 respective manufacturer's products and systems.
- 32 5. Assistance during Demonstration Period functional and performance testing, and until
- 33 product acceptance by the OWNER.
- 34 6. Training of OWNER's personnel in the operation and maintenance of respective product
- 35 as required herein.
- 36 i. See Section 01650 for duration and scheduling of training sessions required.
- 37 ii. Training may be specified as either during the Pre-Demonstration Period or Post
- 38 Demonstration.
- 39 7. Completion of Manufacturer's Certificate of Proper Installation as include in Section
- 40 01650 with applicable certificates for proper installation and initial, interim, and final test
- 41 service.
- 42 8. Complete Certificate of Successful Start-up as defined in Section 01650.

43 **END OF SECTION**

1 **SECTION 15106**
2 **CHECK VALVES**

3 **PART 1 - GENERAL**

4 **1.1 SUMMARY**

- 5 A. Section Includes:
6 1. Check valves.
- 7 B. Related Sections include but are not necessarily limited to:
8 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
9 2. Division 1 - General Requirements.
10 3. Section 15100 - Valves: Basic Requirements.

11 **1.2 QUALITY ASSURANCE**

- 12 A. Referenced Standards:
13 1. American National Standard Institute (ANSI):
14 a. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.
15 2. American Water Works Association (AWWA):
16 a. C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
17 b. C508, Swing Check Valves for Waterworks Service, 2 through 24 IN NPS.
18 3. Manufacturer's Standardization, Society of the Valve and Fittings Industry, Inc (MSS):
19 a. SP-9, Spot Facing for Bronze, Iron and Steel Flanges.
20 b. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
21 c. SP-80, Bronze Gate, Globe, Angle and Check Valves.

22 **1.3 SUBMITTALS**

- 23 A. Shop Drawings:
24 1. See Section 15100.
- 25 B. Operation and Maintenance Manuals:
26 1. See Section 01340.

27 **PART 2 - PRODUCTS**

28 **2.1 ACCEPTABLE MANUFACTURERS**

- 29 A. Subject to compliance with the Contract Documents, manufacturers listed under the valve with
30 types are acceptable.
- 31 B. Submit requests for substitution in accordance with Specification Section 01640.

32 **2.2 CHECK VALVES: 2 IN AND SMALLER**

- 33 A. Class 125 Bronze Swing Check (Utility Air, Water, Wastewater):
34 1. Comply with MSS SP-80.
35 2. Acceptable manufacturers:
36 a. Nibco 413B.
37 b. Stockham B319.
38 c. Or approved equal.
39 3. Materials:
40 a. Body, bonnet, disc: Bronze.
41 4. Design requirements:

- 1 a. 200 psi WOG.
- 2 b. Horizontal swing, renewable disc.
- 3 B. Class 150 Bronze Lift Check (Utility Air):
- 4 1. Comply with MSS SP-80.
- 5 2. Acceptable manufacturers:
- 6 a. Stockham B322.
- 7 b. Powell 158B.
- 8 c. Or approved equal.
- 9 3. Materials:
- 10 a. Body, cap, disc holder: Bronze.
- 11 b. Disc: Buna-N.
- 12 4. Design requirements:
- 13 a. 150 psi to 150 DegF, 300 psi WOG.
- 14 b. Lift check, union cap.

15 **2.3 SWING CHECK: VALVES (3 TO 24 IN)**

- 16 A. Swing Check Valve (Water):
- 17 1. Comply with AWWA C508.
- 18 2. Acceptable manufacturers:
- 19 a. Stockham Valve and Fittings.
- 20 b. Gulf.
- 21 c. Cla-Val.
- 22 d. APCO.
- 23 e. Clow.
- 24 f. American Darling.
- 25 g. Golden Anderson.
- 26 h. Or approved equal.
- 27 3. Materials:
- 28 a. Body and cover: Cast iron.
- 29 b. Seat ring, hinge: Bronze.
- 30 c. Disc:
- 31 1) 3 to 4 IN: Bronze.
- 32 2) 6 to 24 IN: Cast iron with bronze face.
- 33 3) 6 to 24 IN: Cast iron with rubber face.
- 34 d. Hinge shaft: Stainless steel.
- 35 e. Bearings, connecting hardware: Bronze.
- 36 4. Design requirements:
- 37 a. 175 psi working pressure (3 to 12 IN).
- 38 b. 150 psi working pressure (14 to 24 IN).
- 39 c. Furnish with outside weight and lever or lever and spring.

40 **2.4 DOUBLE DOOR CHECK VALVES**

- 41 A. Class 150.
- 42 B. Acceptable Manufacturers:
- 43 1. APCO. Series 9000 (2 to 48 IN).
- 44 2. Nibco W920W (2 to 24 IN).
- 45 3. Valmatic Type 1400.
- 46 4. Centerline Series 800.
- 47 5. Or approved equal.
- 48 C. Materials:
- 49 1. Body: Cast iron threaded lug style.
- 50 2. Doors:
- 51 a. 2 to 12 IN: Aluminum bronze.

- 1 b. 14 to 54 IN: Ductile iron, bronze faced.
- 2 3. Hinge and stop pins: Stainless steel, 316.
- 3 4. Spring: Stainless Steel, T316.
- 4 5. Seat: Buna-N.
- 5 D. Design Requirements:
- 6 1. Wafer style, designed to fit between ANSI flanges.
- 7 2. Resilient seated and watertight.

8 **2.5 BALL CHECK VALVES (1/2 TO 4 IN)**

- 9 A. 150 psi at 73 DegF.
- 10 B. Acceptable Manufacturers:
- 11 1. R&G Sloane.
- 12 2. Corr Tech.
- 13 3. Chemline.
- 14 4. Or approved equal.
- 15 C. Materials:
- 16 1. Body: Same as piping.
- 17 2. Ball: Glass filled or polypropylene.
- 18 3. Seals: Viton or EPDM.
- 19 D. Design Requirements:
- 20 1. Suitable for chemical pump discharge.
- 21 2. Connectors: Double union.
- 22 3. Double ball check design.

23 **PART 3 - EXECUTION**

24 **3.1 INSTALLATION**

- 25 A. See Section 15100.
- 26 B. Install in accordance with manufacturer's instructions.

27 **3.2 FIELD QUALITY CONTROL**

- 28 A. Provide Manufacturer's Field Services as defined in Section 01650 to provide the following
- 29 services:
- 30 1. Assistance during installation to include observation, guidance, instruction of
- 31 CONTRACTOR's assembly, erection, installation or application procedures.
- 32 2. Inspection, checking, and adjustment as required for equipment to function as warranted
- 33 by manufacturer and necessary to provide written approval of installation.
- 34 3. Revisiting the site as required to correct problems and until installation and operation are
- 35 acceptable to OWNER.
- 36 4. Resolution of assembly or installation problems attributable to, or associated with,
- 37 respective manufacturer's products and systems.
- 38 5. Assistance during Demonstration Period functional and performance testing, and until
- 39 product acceptance by the OWNER.
- 40 6. Training of OWNER's personnel in the operation and maintenance of respective product
- 41 as required herein.
- 42 i. See Section 01650 for duration and scheduling of training sessions required.
- 43 ii. Training may be specified as either during the Pre-Demonstration Period or Post
- 44 Demonstration.
- 45 7. Completion of Manufacturer's Certificate of Proper Installation as include in Section
- 46 01650 with applicable certificates for proper installation and initial, interim, and final test
- 47 service.

1

8. Complete Certificate of Successful Start-up as defined in Section 01650.

2

END OF SECTION

1 2000/09/13

2 **SECTION 15114**
3 **MISCELLANEOUS VALVES**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

6 A. Section Includes:

- 7 1. Air release and vacuum relief valves.
8 2. Back flow preventers.
9 3. Float-operated valves (2 IN and smaller).
10 4. Needle valves.
11 5. Pressure-reducing valves (2 IN and smaller).
12 6. Pressure-reducing valves (Greater than 2 IN).
13 7. Pressure relief valves (1 IN and smaller).
14 8. Reduced Pressure Backflow Preventer.
15 9. Solenoid valves.

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

- 17 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
18 2. Division 1 - General Requirements.
19 3. Section 11005 - Equipment: Basic Requirements.
20 4. Section 15100 - Valves: Basic Requirements.

21 **1.2 QUALITY ASSURANCE**

22 A. Referenced Standards:

- 23 1. American Gas Association (AGA).
24 2. American National Standards Institute (ANSI):
25 a. B16.1, Cast-Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.
26 3. American Water Works Association (AWWA):
27 a. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
28 b. C550, Protective Epoxy Interior Coatings for Valves and Hydrants.

29 **1.3 SUBMITTALS**

30 A. Shop Drawings:

- 31 1. See Section 15100.

32 B. Operation and Maintenance Manuals:

- 33 1. See Section 01340.

34 C. Test reports as required in Field Quality Control in Part 3.

35 **PART 2 - PRODUCTS**

36 **2.1 ACCEPTABLE MANUFACTURERS**

37 A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific
38 valve types are acceptable.

39 B. Submit requests for substitution in accordance with Specification Section 01640.

40 **2.2 AIR RELEASE AND VACUUM RELIEF VALVES**

41 A. General:

- 1 1. Conform to AWWA C512.
- 2 B. Air Release Valve (Water):
- 3 1. Acceptable manufacturers:
- 4 a. APCO 140 Series (1/2 IN thru 3").
- 5 b. APCO 140-C Series (4 IN and up).
- 6 c. Or approved equal.
- 7 2. Materials:
- 8 a. Body and cover: Cast iron, semi-steel, or nylon.
- 9 b. Interior coating: Epoxy coat all wetted metallic parts, NSF approved for potable water
- 10 use and resistant to acids, bases, and oxidants.
- 11 c. Float: Stainless steel or polypropylene.
- 12 d. Linkage and trim: Bronze or stainless steel.
- 13 e. Seats: Viton, EPDM, or Teflon and compatible with service fluid.
- 14 3. Design requirements:
- 15 a. Working pressure: 175 psi or equal to the test pressure, whichever is greater.
- 16 b. Release 10 cfm at 10 psi differential at 150 psi line pressure.
- 17 C. Air Release Valve (BWR & CCW Lines):
- 18 1. Acceptable manufacturers:
- 19 a. GA Industries.
- 20 b. APCO.
- 21 c. Valmatic Model 15A.
- 22 d. Or approved equal.
- 23 2. Materials:
- 24 a. Body and cover: Cast iron or semi-steel.
- 25 b. Float and linkage: Stainless steel.
- 26 c. Seat: Viton or Buna-N.
- 27 3. Design requirements:
- 28 a. Working pressure 100 psi.
- 29 b. Inlet 1/2 IN NPT, outlet 1/2 IN NPT.
- 30 c. Flush accessories:
- 31 1) Inlet shut-off valve.
- 32 2) Blow-off valve.
- 33 3) Clear water inlet valve.
- 34 4) Hose and quick disconnect coupling.
- 35 D. Combination Air Release Valves (Water):
- 36 1. Acceptable manufacturers:
- 37 a. GA Industries, Figure 945/980.
- 38 b. APCO Series 1700.
- 39 c. Val-Matic Model 100.
- 40 d. A.R.I.
- 41 e. Or approved equal.
- 42 f. If Drawings indicate valve size other than as specified in this Section, provide valve
- 43 size as indicated on Drawings and valve model number consistent with the style of
- 44 valve specified in this Section.
- 45 2. Materials:
- 46 a. Body and cover: Cast iron or nylon.
- 47 b. Interior coating: Epoxy coat all metallic wetted parts, NSF approved for potable water
- 48 use and resistant to acids, bases, and oxidants.
- 49 c. Float, linkage and hardware: Stainless steel or polypropylene.
- 50 d. Seat: Viton, EPDM, or Teflon and compatible with service fluid.
- 51 3. Design requirements:
- 52 a. Working pressure: 150 psi or system test pressure, whichever is greater.
- 53 b. Release 10 cfm at 10 psi differential at 150 psi line pressure.
- 54 c. Air vacuum capacity 5 scfm at 5 psi differential from atmospheric.

- 1 d. Unit may be combined in one valve body or be duplex type.
- 2 e. Provide surge check unit for valves over 4 IN.
- 3 f. Provide isolation valve:
- 4 1) Ball valve for less than 4 IN.
- 5 E. Vacuum Relief Valves (Water):
- 6 1. Acceptable manufacturers:
- 7 a. Valmatic Model 100.
- 8 b. GA Industries Model 930.
- 9 c. APCO Model 140.
- 10 d. Or approved equal.
- 11 2. Lever type operation.
- 12 3. Materials of construction:
- 13 a. Body: Cast or ductile iron.
- 14 b. Interior coating: Epoxy coat all wetted parts, NSF approved for potable water use and
- 15 resistant to acids, bases, and oxidants.
- 16 c. Trim: Stainless steel.
- 17 d. Float: 304 stainless steel.
- 18 e. Seals: Viton, EPDM, or Teflon and compatible with service fluid.
- 19 F. Valves for Chemical Lines:
- 20 1. PVC body valves similar to that specified above may be used in these applications.

21 **2.3 FLOAT-OPERATED VALVES (2 IN AND SMALLER)**

- 22 A. Acceptable Manufacturers:
- 23 1. GA Industries, Figure 64 (70 psi).
- 24 2. Figure 52 (175 psi).
- 25 3. Or approved equal.
- 26 B. Materials:
- 27 1. All 316 stainless steel except:
- 28 a. Seat: EPDM or Teflon (must be compatible with service fluid).
- 29 b. Float: 316 stainless steel.
- 30 C. Design Requirements:
- 31 1. Working pressure: 150 psi or equal to system test pressure, whichever is greater.
- 32 2. Direct float connected and mechanically actuated.

33 **2.4 NEEDLE VALVES**

- 34 A. General service
- 35 1. Acceptable manufacturer:
- 36 a. Swagelok (Whitey) Models 1R and 18R.
- 37 b. Parker.
- 38 c. Circle Seal.
- 39 2. The valve shall be all 316 stainless steel with a regulating stem.
- 40 B. Isolation valve for instrumentation
- 41 1. Acceptable manufacturers:
- 42 a. Anderson Greenwood.
- 43 b. Parker.
- 44 c. Swagelok (Whitey).
- 45 2. For all pressure transmitters, provide a needle isolation valve with a bleed valve located on
- 46 the transmitter side of the process.
- 47 3. Valves are to be provided with a T-type handle.
- 48 4. Calibration piping and transmitter connections shall share and sense the same pressure.
- 49 5. The calibration piping connection is plugged during normal operation. Calibration shall be
- 50 performed by removing the pipe plug.

1 6. Materials of construction: All Type 316 stainless steel.

2 **2.5 PRESSURE-REDUCING VALVES (2 IN AND SMALLER)**

3 A. Water Pressure Regulators:

4 1. Acceptable manufacturers:

- 5 a. Fisher, Type 75A.
- 6 b. Mueller, Model H9300.
- 7 c. Watt.
- 8 d. Or approved equal.

9 2. Materials:

- 10 a. Body: Bronze.
- 11 b. Strainer body: Bronze.
- 12 c. Strainer screen: Stainless steel.
- 13 d. Interior coating: Epoxy coat all metallic wetted parts, NSF approved for potable water
- 14 use and resistant to acids, bases, and oxidants.

15 3. Design requirements:

- 16 a. Self-contained diaphragm operated.
 - 17 1) Spring loaded.
 - 18 2) Field adjustable.
- 19 b. Strainer: Y-type on supply.
- 20 c. Size as shown in Schedule or size equal to connecting line size with 125 psi inlet and
- 21 50 psi outlet pressure.

22 B. Air Pressure Regulators:

23 1. Acceptable manufacturers:

- 24 a. Air service:
 - 25 1) Fisher 64 Series.

26 2. Design requirements:

- 27 a. Self-contained, diaphragm operated.
 - 28 1) Spring loaded.
 - 29 2) Field adjustable.

30 **2.6 PRESSURE-REDUCING VALVES (GREATER THAN 2 IN)**

31 A. Water Pressure Regulators: Tag No. PRV-9482.

32 1. Acceptable manufacturers:

- 33 a. Cla-Val Model 90-01/690-01.
- 34 b. Or approved equal.

35 2. Materials:

- 36 a. Body: Ductile iron.
- 37 b. Strainer body: Bronze.
- 38 c. Strainer screen: Stainless steel.

39 3. Design requirements:

- 40 a. Pilot operated.
 - 41 1) Control pilot handwheel or adjusting screw.
 - 42 2) Control pilot shall allow field adjustment from near 0 psi to 10% greater than pre-
 - 43 set pressure.
- 44 b. Strainer: Y-type on supply.
- 45 c. Size as shown in Schedule or size equal to connecting line size with 125 psi inlet and
- 46 25 psi outlet pressure.
- 47 d. Globe-style body.

48 B. Air Pressure Regulators:

49 1. Acceptable manufacturers:

- 50 a. Air service:
 - 51 1) Fisher 64 Series.

52 2. Design requirements:

- 1 a. Self-contained, diaphragm operated.
- 2 1) Spring loaded.
- 3 2) Field adjustable.

4 **2.7 PRESSURE RELIEF VALVE (1 IN AND SMALLER)**

5 A. Acceptable Manufacturers:

- 6 1. Fisher 98 Series.
- 7 2. Fisher H2000 Series for air.
- 8 3. Or approved equal.

9 B. Materials:

- 10 1. Body: Cast iron coated or Stainless steel.
- 11 2. Interior coating: Epoxy coat all metallic wetted parts, NSF approved for potable water use
- 12 and resistant to acids, bases, and oxidants.
- 13 3. Spring: Steel. Material to be compatible with fluid.
- 14 4. Diaphragm: water – neoprene and air - 302 stainless steel.
- 15 5. Trim: 416 stainless steel.

16 C. Design Requirements:

- 17 1. Pipe relief to discharge at non-hazardous location.
- 18 2. Relief pressure: Dependant on system operating and/or test pressure. Initial relief to be
- 19 operating pressure plus 10 percent.

20 **2.8 REDUCED PRESSURE BACKFLOW PREVENTER: TAG NO. BFP-9496 & BFP-9697**

- 21 A. Backflow preventers consist of two check valves, test cocks and relief valve, all assembled as an
- 22 integral unit.
- 23 B. Reduced pressure backflow preventers: Wilkins 975XLSE, AMES 4000SS or approved equal.
- 24 C. Backflow preventer to have threaded ends in sizes through 2 IN, flanged 2-1/2 IN and larger.
- 25 D. Pressure loss through backflow preventer not to exceed 16 psi at design flow.
- 26 E. If outside, provide thermal protection enclosure. Thermal protection enclosure shall be
- 27 manufactured by Hot Box, Inc. or approved equal.
- 28 1. The enclosure shall be constructed of fiberglass reinforced plastic.
- 29 2. Insulation shall be spray-applied polyisocyanurate foam minimum thickness of 1 ½" thick to
- 30 provide a minimum R value of 8.
- 31 F. Provide air gap and pipe discharge to within 6 IN of finished floor.

32 **2.9 SOLENOID VALVES (1 IN AND SMALLER)**

33 A. General Service (Air - Water):

- 34 1. Acceptable manufacturers:
- 35 a. Two-way ASCO Models 8262 (¼ Inch), 8030 or 8210 (larger than ¼ Inch).
- 36 b. Two-way ASCO Model 2862, 8030, 8210, and 8215 for vacuum service.
- 37 c. Three -way ASCO Model 8300.
- 38 d. Four-way ASCO Model 8344.
- 39 e. Or approved equal.
- 40 2. Materials:
- 41 a. Body: Brass.
- 42 b. Seat: Buna-N.
- 43 c. Insulation: Class F.
- 44 3. Design requirements:
- 45 a. 110 Vac.
- 46 b. Two-way, normally closed.
- 47 c. Enclosure: Compatible with area classifications indicated on Drawings.
- 48 d. Working pressure, air and water: 150 psig.

- 1 4. Accessories:
2 a. Provide strainer on supply.

3 **2.10 ACCESSORIES**

- 4 A. Furnish any accessories required to provide a completely operable valve.

5 **2.11 FABRICATION**

- 6 A. Completely shop assemble unit including any interconnecting piping, speed control valves,
7 control isolation valves and electrical components.
8 B. Provide internal epoxy coating suitable for potable water for all iron body valves in accordance
9 with AWWA C550.

10 **2.12 SOURCE QUALITY CONTROL**

- 11 A. Shop hydrostatically test to piping system test pressure.

12 **2.13 MAINTENANCE MATERIALS**

- 13 A. Provide one set of any special tools or wrenches required for operation or maintenance for each
14 type valve.

15 **PART 3 - EXECUTION**

16 **3.1 INSTALLATION**

- 17 A. General:
18 1. See Section 11005 and Section 15100.
19 B. Air Release, Vacuum Relief, and Pressure Relief Valves:
20 1. Pipe exhaust to a suitable disposal point.
21 2. Where exhausted to a trapped floor drain, terminate exhaust line 6 IN minimum above floor.
22 C. Float-Operated Valves:
23 1. Install baffle around float to minimize turbulence adjacent to float.

24 **3.2 FIELD QUALITY CONTROL**

- 25 A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.
26 B. Check and adjust valves and accessories in accordance with manufacturer's instructions and
27 place into operation.
28 C. Provide Manufacturer's Field Services as defined in Section 01650 to provide the following
29 services:
30 1. Assistance during installation to include observation, guidance, instruction of
31 CONTRACTOR's assembly, erection, installation or application procedures.
32 2. Inspection, checking, and adjustment as required for equipment to function as warranted by
33 manufacturer and necessary to provide written approval of installation.
34 3. Revisiting the site as required to correct problems and until installation and operation are
35 acceptable to OWNER.
36 4. Resolution of assembly or installation problems attributable to, or associated with,
37 respective manufacturer's products and systems.
38 5. Assistance during Demonstration Period functional and performance testing, and until
39 product acceptance by the OWNER.
40 6. Training of OWNER's personnel in the operation and maintenance of respective product as
41 required herein.
42 7. See Section 01650 for duration and scheduling of training sessions required.

- 1 8. Training may be specified as either during the Pre-Demonstration Period or Post
- 2 Demonstration.
- 3 9. Completion of Manufacturer's Certificate of Proper Installation as include in Section 01650
- 4 with applicable certificates for proper installation and initial, interim, and final test service.
- 5 10. Complete Certificate of Successful Start-up as defined in Section 01650.
- 6 11. The CONTRACTOR to provide certification testing of any backflow preventers after
- 7 installation. Testing should be by a TCEQ certified backflow prevention specialist. Submit
- 8 test results to engineer.

9

END OF SECTION

1 2002/01/14

2 **SECTION 15183**
3 **PIPE INSULATION**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Insulation:
- 8 a. Piping insulation.
- 9 B. Related Sections include but are not necessarily limited to:
- 10 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- 11 2. Division 1 - General Requirements.
- 12 3. Section 11005 - Equipment: Basic Requirements.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:
- 15 1. ASTM International (ASTM):
- 16 a. C177, Steady-State Thermal Transmission Properties by means of Guarded Hot Plate.
- 17 b. C411, Standard Test Method for Hot-Surface Performance of High-Temperature
- 18 Thermal Insulation.
- 19 c. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients
- 20 by the Reverberation Room Method.
- 21 d. C518, Steady-State Thermal Transmission Properties by means of the Heat Flow Meter.
- 22 e. C534, Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and
- 23 Tubular Form.
- 24 f. D1056, Flexible Cellular Sponge or Expanded Rubber.
- 25 g. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- 26 h. E96, Water Vapor Transmission of Materials in Sheet Form.
- 27 2. National Fire Protection Association (NFPA):
- 28 a. 90A, Air Conditioning and Ventilating Systems.
- 29 b. 90B, Warm Air Heating and Air Conditioning Systems.
- 30 c. 255, Surface Burning Characteristics of Building Materials.
- 31 3. Underwriters Laboratories, Inc. (UL):
- 32 a. 723, Test for Surface Burning Characteristics of Building Materials.

33 **1.3 SUBMITTALS**

- 34 A. Shop Drawings:
- 35 1. See Section 01340.
- 36 2. Product technical data including:
- 37 a. Acknowledgement that products submitted meet requirements of standards referenced.
- 38 b. Manufacturer's installation instructions.
- 39 c. Submit complete specification of insulation materials, adhesives, cement, together with
- 40 manufacturer's recommended methods of application and coverage for coatings and
- 41 adhesives.
- 42 3. Submit itemized schedule by building of proposed insulation systems showing density,
- 43 thermal conductivity, thickness, adhesive, jackets and vapor barriers.
- 44 4. Certifications:
- 45 a. Products will meet the requirements of the Contract Documents.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are
4 acceptable:

- 5 1. Elastomeric insulation:
 - 6 a. Rubatex.
 - 7 b. Armstrong.
- 8 2. Fiberglass insulation:
 - 9 a. Certainteed Corporation.
 - 10 b. Schuller (Manville).
 - 11 c. Owens Corning.
 - 12 d. Knauf.
- 13 3. PVC jacket:
 - 14 a. Ceel-Co.
 - 15 b. PIC Plastics.

16 B. Submit requests for substitution in accordance with Section 01640.

17 **2.2 PIPING INSULATION: ELASTOMERIC**

18 A. General:

- 19 1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and
20 adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM
21 E84, NFPA 255 and UL 723, not exceeding:
 - 22 a. Flame spread: 25.
 - 23 b. Smoke developed: 100.
- 24 2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed
25 above.
- 26 3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed
27 above requirements.
- 28 4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
29 Water-soluble treatments is prohibited.
- 30 5. Insulated shields at pipe support points.

31 B. Pipe, Fitting, and Valve Insulation:

- 32 1. Flexible elastomeric closed cell pipe insulation. Average thermal conductivity not to exceed
33 0.27 (Btu-IN) per square foot-DegF-hour at mean temperature of 75 DegF, temperature
34 range -40 to 220 DegF; permeability not to exceed 0.20 by ASTM E96; water absorption 3
35 percent by ASTM D1056 and ozone resistance.
- 36 2. Provide minimum insulation thickness conforming to schedules or as shown on the
37 Drawings.

38 **2.3 PIPING INSULATION: FIBERGLASS**

39 A. Pipe and Fitting Insulation:

- 40 1. Preformed fiberglass pipe insulation:
 - 41 a. Density: 4 LBS/CF.
 - 42 b. Temperature rated: 650 DegF.
 - 43 c. Average thermal conductivity not to exceed 0.22 (Btu-IN) per square foot-DegF-hour at
44 mean temperature of 75 DegF.
 - 45 d. Fire hazard rating:
 - 46 1) UL 723, ASTM E84, NFPA 255.
 - 47 2) Flame spread not exceeding 25 and smoke developed not exceeding 100.
- 48 2. Moisture adsorption:
 - 49 a. ASTM C553.

- 1 b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at
- 2 120 DegF and 96 percent RH.
- 3 3. Fungi and bacteria resistance:
- 4 a. ASTM C665.
- 5 b. Does not breed or promote growth.
- 6 c. Flame attenuated glass fibers bonded with thermosetting resin.
- 7 4. Piping jackets (general applications):
- 8 a. PVC: Preformed 0.028 IN thick PVC jackets fabricated from B. F. Goodrich PVC
- 9 sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do
- 10 not exceed the limits of PVC.
- 11 b. Piping jacket not required on concealed piping.
- 12 5. Provide minimum insulation thickness conforming to schedules or as shown on the
- 13 Drawings.

14 **2.4 SUBSTITUTION**

- 15 A. Submit request for substitution in accordance with Specification Section 01640.

16 **PART 3 - EXECUTION**

17 **3.1 INSTALLATION**

- 18 A. Install products in accordance with manufacturer's instructions.
- 19 B. General:
- 20 1. Consider piping as exposed, except as otherwise indicated.
- 21 2. Consider piping in walls, partitions, floors, pipe chases, and pipe shafts as concealed.
- 22 Consider piping above ceilings as concealed.
- 23 3. Provide release for insulation application after installation and testing is complete. Apply
- 24 insulation on clean, dry surfaces after inspection.
- 25 4. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers,
- 26 supports and sleeves.
- 27 5. Provide insulation with vapor barrier for piping where surfaces may be cooler than
- 28 surrounding air temperatures. Provide vapor barrier (0.17 perm-IN; ASTM C553)
- 29 continuous and unbroken. Hangers, supports, anchors, and related items that are secured
- 30 directly to cold surfaces must be adequately insulated and vapor-sealed to prevent
- 31 condensation.
- 32 6. Apply specified adhesives, mastics and coatings at the manufacturer's recommended
- 33 coverage per unit volume.
- 34 C. Piping Insulation: Elastomeric:
- 35 1. Slip insulation on pipe prior to connection. Whenever the slip-on technique is not possible
- 36 provide insulation neatly slit and snapped over the pipe.
- 37 2. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
- 38 3. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive,
- 39 recommended by the insulation manufacturer, to ensure complete vapor barrier.
- 40 D. Piping Insulation: Fiberglass:
- 41 1. Apply over clean dry pipe. Butt all joints together firmly.
- 42 2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the
- 43 insulation manufacturer.
- 44 3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
- 45 4. PVC pipe jacket:
- 46 a. Apply jacketing with a minimum of 1 IN overlap. Weld longitudinal and
- 47 circumferential seams with adhesives as recommended by manufacturer.
- 48 b. Provide slip-joints every 30 FT and between fittings if distance exceeds 8 FT. Construct
- 49 slip-joints by overlapping jacket sections 6 to 10 IN.

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c. Provide premolded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.

3.2 REPAIR

A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship.

3.3 SCHEDULES

- A. Refrigeration Lines (35-60 DegF):
1. Elastomeric.
2. 1/2 IN thickness for lines 1 IN and smaller.

B. Pipe, Fittings and Valves:

APPLICATION	PIPE SIZE	THICKNESS	JACKET
Hot Water (domestic)	6 IN and less	3/4 IN	PVC
Cold Water (domestic)	3 IN and less	3/4 IN	PVC
	Over 3 IN	1 IN	
Refrigeration Lines (35 - 60 DegF)	Over 1 IN	1 IN	PVC
	2 IN and less	1 IN	PVC
Condensate			

END OF SECTION

2 **SECTION 15440**
3 **PLUMBING FIXTURES AND EQUIPMENT**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Plumbing fixtures, trim, and equipment.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 07900 - Joint Sealants.
12 4. Section 11005 - Equipment: Basic Requirements.
13 5. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.

14 **1.2 QUALITY ASSURANCE**

- 15 A. Referenced Standards:
16 1. American National Standard Institute (ANSI):
17 a. Z358.1, Emergency Eyewash and Shower Equipment.
18 2. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
19 a. 90.1, Energy Efficient Design of New Buildings Except Low-Rise Residential
20 Buildings.
21 3. American Gas Association (AGA).
22 4. American Society of Mechanical Engineer (ASME).
23 5. American Society of Mechanical Engineer (ASME)/American National Standards Institute
24 (ANSI):
25 a. ASME/ANSI A112.19.3M, Stainless Steel Plumbing Fixtures (Designed for Residential
26 Use).
27 6. American Society of Sanitation Engineers (ASSE):
28 a. 1011, Performance Requirements for Hose Connections Vacuum Breakers.
29 7. National Sanitation Foundation (NSF).
30 8. Underwriters Laboratories, Inc. (UL).

31 **1.3 SUBMITTALS**

- 32 A. Shop Drawings:
33 1. See Section 11005 and Section 15060.
34 2. Color selection charts for Owner color selection.
35 3. Fabrication and/or layout drawings:
36 a. Layout plan(s) showing dimensions, elevations, etc.
37 b. Details showing connections, installation, rough-in locations, etc.
38 4. Product technical data including:
39 a. Acknowledgement that products submitted meet requirements of standards referenced.
40 b. Manufacturer's installation instructions.
41 c. Chemical-resistance data.
- 42 B. Operation and Maintenance Manuals:
43 1. See Section 01340.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are
4 acceptable:

- 5 1. Emergency shower and eyewash:
6 a. Speakman.
7 b. Haws.
8 c. Guardian.
9 d. Encon.
10 2. Electric water coolers:
11 a. Halsey-Taylor.
12 b. Elkay.
13 c. Haws.
14 d. Oasis.
15 e. Sunroc.
16 3. Drains and water hammer arrestors:
17 a. Wade.
18 b. Josam.
19 c. Zurn.
20 d. Smith.
21 e. Watts.
22 f. Mifab.
23 4. Trap primer:
24 a. Precision Plumbing Products.
25 5. Hydrants:
26 a. Wade.
27 b. Josam.
28 c. Smith.
29 6. Electric water heater:
30 a. A. O. Smith.
31 b. Ruud.
32 c. Rheem.

33 B. Submit requests for substitution in accordance with Specification Section 01640.

34 **2.2 MANUFACTURED UNITS**

35 A. Emergency Fixtures:

- 36 1. Emergency shower and eye/face wash (ESEW): ANSI Z358.1.
37 a. Flow control:
38 1) Rating: 30 GPM.
39 b. Deluge shower head:
40 1) Stay-open ball valve.
41 2) Pull-rod.
42 3) ABS head.
43 c. Eye/face wash:
44 1) Aerated eye/face wash with ABS bowl.
45 2) Stay-open full port ball valve.
46 3) Push handle control for eye/face wash.
47 4) Supply line strainer for eye/face wash.
48 d. Corrosion-resistant CRP coating.
49 e. Type:
50 1) ESEW-1 (barrier-free, corrosion-resistant plastic and pull rod for shower):
51 Haws 8200WCCRP.

- 1 B. Drains:
- 2 1. Floor drain (FD):
- 3 a. Bottom outlet.
- 4 b. Clamping seepage flange.
- 5 c. Seepage openings.
- 6 d. Size as shown on Drawings.
- 7 e. Type: Polyvinyl chloride (PVC) body.
- 8 1) FD-1 (unfinished area) sediment bucket, bucket shall support grate:
- 9 Mifab F1102-P-C-7-30-5-3STD6.
- 10 C. Traps:
- 11 1. Floor drains:
- 12 a. Same material and coating as the piping system.
- 13 b. 2 IN minimum seal.
- 14 c. With accessories as noted on Contract Drawings.
- 15 2. Fixture drains:
- 16 a. 2 IN minimum seal.
- 17 b. Cast brass.
- 18 c. Chrome plated.
- 19 d. Size as required.
- 20 D. Cleanouts (CO):
- 21 1. Cleanouts for PVC pipe: Heavy PVC screw plug with solid hexagonal nut for exposed
- 22 piping.
- 23 2. Cleanouts installed in completely accessible pipe chases or where piping is exposed do not
- 24 require special covers.
- 25 E. Hose Bibb (HB-1):
- 26 1. 3/4 IN with attached vacuum breaker-backflow preventer.
- 27 2. Vacuum breaker: Non-removable, manual draining, meeting the requirements of the ASSE
- 28 1011.
- 29 3. HB-1: Woodford 24P.
- 30 F. Hydrants (WH):
- 31 1. Wall hydrant:
- 32 a. Non-freeze.
- 33 b. Integral vacuum breaker.
- 34 c. Nylon seat.
- 35 d. 3/4 IN hose connection.
- 36 e. 3/4 IN inlet connection.
- 37 f. Length as recommended by manufacturer for wall thickness.
- 38 g. Type:
- 39 1) WH-2 (wall box) Woodford B24.
- 40 G. Electric Water Heater (EWH):
- 41 1. Electric tank type:
- 42 a. Size and capacity as scheduled.
- 43 b. Underwriters Laboratories, Inc. (UL) listed.
- 44 c. Internal surfaces: Glass-lined with alkaline borosilicate composition fused-to-steel.
- 45 1) Provide magnesium rods rigidly supported for cathodic protection.
- 46 d. Low watt density heating elements with zinc-plated copper sheath.
- 47 1) Provide thermostat with each element, high temperature cutoff and temperature and
- 48 pressure relief valve.
- 49 e. Insulate tank with vermin-proof glass fiber insulation or equal.
- 50 f. Heavy gage steel jacket with baked enamel finish.
- 51 g. Warranty against corrosion for 3-year period.
- 52 h. Provide water heaters meeting ASHRAE 90.1 for energy efficiencies.

1 **PART 3 - EXECUTION**

2 **3.1 INSTALLATION**

3 A. Cross Connection:

- 4 1. Do not install any plumbing components that will provide a cross connection between
5 potable and non-potable or drainage systems.

6 B. Fixtures:

- 7 1. Install fixtures at locations indicated on Drawings and in compliance with local codes.
8 2. Connect plumbing supply, drain and vent line sizes as shown on Drawings.
9 3. Set proper grounds to form secure base for each fixture and rigid setting.
10 4. Seal fixture joints abutting walls and floors with silicone sealant.
11 5. Connect exposed traps and supply pipes for fixtures and equipment to rough piping systems
12 at wall, unless otherwise specified.

13 C. Drains:

- 14 1. Install drains at locations indicated on Drawings and in compliance with local codes.
15 2. In uncovered concrete slabs:
16 a. Install at the low points of surface areas to be drained or as indicated.
17 b. Set tops of drains flush with the finished floor.
18 c. Install drain flashing collar or a flange so that no leakage occurs between the drain and
19 the adjoining surfaces.
20 d. Maintain the integrity of waterproof membranes, where penetrated.

21 D. Wall Hydrants:

- 22 1. Install 24 IN above exterior grade.
23 2. Support units from the structure and mount flush with structure face.
24 3. Prior to final setting, fill the back of the face with a non-hardening silicone calk and press
25 firmly in place to stop infiltration and water leakage.
26 4. Install isolation valves in line to each wall hydrant.

27 E. Hose Bibbs:

- 28 1. Install 36 IN above finished floor.

29 F. Water Hammer Arrestors:

- 30 1. Install on hot and cold water lines adjacent to each battery of fixtures or other equipment
31 where indicated on Drawings.
32 2. Size as recommended by manufacturer for length of pipe served.
33 3. Runouts to hose bibbs and wall hydrants do not require air chambers.
34 4. Install units vertically on top of pipe or as detailed on the Drawings.

35 G. Cleanouts:

- 36 1. Install cleanouts:
37 a. Above floor in each vertical riser that connects to horizontal branch below floor.
38 b. As required by local code.

39 H. Wall Plates and Escutcheons:

- 40 1. Install as specified in Section 15060 or this Section.

41 I. Water Heater:

- 42 1. Install all water heaters in accordance with details, manufacturer's recommendations, and
43 applicable codes.
44 2. For units located on concrete pads, plumb level and orient to allow access to the controls,
45 elements and other items requiring service.
46 3. Connect hot and cold water piping to the unit with line-size, isolation valves and dielectric
47 unions.
48 4. Provide heat traps in accordance with the International Energy Conservation Code.
49 5. Start up the unit and adjust all controls for proper temperature control and maximum
50 efficiency.

2 **SECTION 15605**
3 **HVAC - EQUIPMENT**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Heating, ventilating, and cooling equipment.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 11005 - Equipment: Basic Requirements.
12 4. Section 13448 - Control Panels and Enclosures.
13 5. Section 15990 - HVAC Systems: Balancing and Testing.
14 6. Division 16 - Electrical.

15 **1.2 QUALITY ASSURANCE**

- 16 A. Referenced Standards:
17 1. Air Movement and Control Association (AMCA):
18 a. 210, Laboratory Methods of Testing Fans for Rating Purposes.
19 b. AS401, Fans, Standard Classifications for Spark-Resistant Construction.
20 2. Air Conditioning and Refrigeration Institute (ARI):
21 a. 410, Force-Circulation Air-Cooling and Air-Heating Coils.
22 b. 430, Central Station Air-Handling Units.
23 3. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
24 a. Applications Handbook, Chapter on Sound and Vibration Control.
25 4. National Electrical Manufacturers Association (NEMA).
26 a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
27 5. National Fire Protection Association (NFPA):
28 a. 90A, Installation of Air Conditioning and Ventilating Systems.
29 6. National Roofing Contractor Association (NRCA).
30 7. Underwriters Laboratories, Inc. (UL).
- 31 B. Miscellaneous:
32 1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown
33 and Sharpe gage for non-ferrous metals.
34 2. Corrosion protection of equipment to be as specified herein.

35 **1.3 SUBMITTALS**

- 36 A. Shop Drawings:
37 1. See Section 01340.
38 2. Fabrication and/or layout drawings.
39 3. Product technical data including:
40 a. Acknowledgement that products submitted meet requirements of standards referenced.
41 b. Manufacturer's installation instructions.
42 c. Wiring diagrams.
43 d. Control diagrams.
44 e. Manufacturer's catalog cuts and technical data.
45 f. Corrosion-protection information.
46 g. Fan curves.
47 h. Control description.

- 1 i. Performance data on all equipment.
- 2 B. Operation and Maintenance Manuals:
- 3 1. See Section 01340.

4 **PART 2 - PRODUCTS**

5 **2.1 ACCEPTABLE MANUFACTURERS**

- 6 A. Subject to compliance with the Contract Documents, the following manufacturers are
- 7 acceptable:
- 8 1. Corrosion-resistant unit heater - electric:
- 9 a. Q-Mark.
- 10 b. Marley.
- 11 c. Markel.
- 12 d. Berko.
- 13 2. Air-cooled condensing units - split system:
- 14 a. Carrier.
- 15 b. Ruud.
- 16 c. Trane.
- 17 d. York.
- 18 3. Ductless split-system air-handling units:
- 19 a. EMI.
- 20 4. Corrosion-resistant wall-mounted propeller-type exhaust fans:
- 21 a. MK Plastics.
- 22 b. LeRoy.
- 23 B. Submit requests for substitution in accordance with Specification Section 01640.

24 **2.2 GENERAL**

- 25 A. All manufactured units shall be factory wired and assembled.
- 26 1. Use fasteners made of same material as unit.
- 27 2. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
- 28 a. Type: As per Table 42, Chapter 43, ASHRAE Applications Handbook.
- 29 B. Indicated manufactured units shall be constructed with corrosion-resistant materials or have
- 30 corrosion-resistant coating.
- 31 1. Type:
- 32 a. Corrosion-resistant materials:
- 33 1) Stainless steel.
- 34 2) FRP.
- 35 b. Corrosion-resistant coating:
- 36 1) Phenolic-based coating:
- 37 2) 3 mil minimum dry thickness, air-dried coating, for surfaces exposed to
- 38 temperatures less than 150 DegF.
- 39 3) Factory applied.

40 **2.3 MANUFACTURED UNITS**

- 41 A. Corrosion-Resistant Unit Heater - Electric:
- 42 1. UL listed, corrosion-resistant washable.
- 43 2. Material:
- 44 a. Fan: Non-sparking aluminum.
- 45 b. Heater case: Stainless steel.
- 46 c. Type 316 stainless steel elements.
- 47 d. Junction box: NEMA 4X.
- 48 3. Fan motor:

- 1 a. See Section 11005.
- 2 b. Built-in overload protection.
- 3 4. Louvered outlet grille.
- 4 5. Rear grille.
- 5 6. Built-in over temperature protection.
- 6 7. Accessories:
- 7 a. Mounting bracket: Stainless steel.
- 8 Internal thermostat:
- 9 Temperature range 55 - 105 DegF.
- 10 B. Air-Cooled Condensing Units - Split System:
- 11 1. ARI rated.
- 12 2. UL listed.
- 13 3. Materials:
- 14 a. Casing: Galvanized steel.
- 15 b. Mounting/lifting rails: Steel.
- 16 c. Outdoor coil: Seamless aluminum tubing and aluminum fins.
- 17 d. Fan blades: Aluminum.
- 18 4. Weatherproof casing with access panels.
- 19 5. Compressor:
- 20 a. Hermetically sealed.
- 21 b. Internal pressure protector.
- 22 c. Crankcase heater.
- 23 d. Internal spring mounts.
- 24 e. Centrifugal oil pump.
- 25 f. Built-in overload protection.
- 26 6. Condenser fans and motors:
- 27 a. Vertical discharge.
- 28 b. Direct drive.
- 29 c. Statically and dynamically balanced.
- 30 d. Motor: See Section 11005.
- 31 1) Permanently lubricated bearings.
- 32 2) Built-in current and thermal overload protection.
- 33 7. Built-in refrigerant filter dryer.
- 34 8. Built-in liquid line and gas line service valves with gage ports.
- 35 9. Outdoor coil:
- 36 a. Fins mechanically bonded to tubing.
- 37 b. Lab tested to 2000 psi.
- 38 c. Provide low ambient run control. Unit to operate down to 0 DegF outside ambient.
- 39 10. 24 V factory-wired controls to include fusing and control power transformer.
- 40 11. High and low pressure controls.
- 41 12. Hard start kit.
- 42 13. Size and capacity as scheduled on Drawings.
- 43 C. Ductless split-systems air handling units:
- 44 1. ARI certified.
- 45 2. UL listed.
- 46 3. Materials:
- 47 a. Casing: Heavy gage steel.
- 48 b. Framework: Steel angle.
- 49 c. Casing insulation: 1 IN, 3/4 LB fiberglass blanket.
- 50 4. Casing:
- 51 a. Sectionalized construction.
- 52 5. Fan section:
- 53 a. Fans:
- 54 1) Statically and dynamically balanced.
- 55 2) Solid shafts.

- 1 3) Forward curved fans.
- 2 4) Die formed fan housing.
- 3 6. Motors: Factory standard.
- 4 7. Direct drives.
- 5 8. Heating coil section:
- 6 a. Electric: Factory standard.
- 7 9. Cooling coil section:
- 8 a. Direct expansion: Factory standard.
- 9 10. Filter section:
- 10 a. Filters: Factory standard.
- 11 b. Access doors for filter removal.
- 12 11. Control panel for electric heat:
- 13 a. Integral.
- 14 b. Controls and safety devices, factory-wired, in accordance with NEC requirements.
- 15 c. NEMA 12 construction.
- 16 12. Size and capacity as scheduled on Drawings.
- 17 D. Corrosion-resistant wall-mounted propeller-type exhaust fans:
- 18 1. General: Provide fiberglass reinforced plastic (FRP) centrifugal fans of sizes, arrangements,
- 19 accessories and capacities as indicated on Contract Drawings.
- 20 2. Fan units: Provide factory-assembled and tested fan units consisting of a housing, a wheel,
- 21 a fan shaft, bearings and a side support structure.
- 22 3. Housings: Provide curved scroll housings constructed of solid FRP. Inlet and drive side
- 23 stands constructed of steel with interior surface shielded with FRP. Exterior metal surfaces
- 24 to be cleaned and coated with high solids vinyl coating 4 to 5 mils thickness. Inlet and drive
- 25 side plates to be fastened to housing with imbedded, FRP encapsulated Type 316 stainless
- 26 steel bolts. The outlet flange and inlet collar are constructed of solid FRP.
- 27 4. Wheels: Provide backwardly-inclined, plate-type blades constructed of solid FRP. Key
- 28 wheels to shafts. Statically and dynamically balance wheels after assembly.
- 29 5. Shafts: Construct shafts of AISI 1040 or 1045, solid hot-rolled steel, turned, polished and
- 30 encapsulated in FRP through the shaft seal. Provide FRP stuffing box and gasketed housing
- 31 shaft seal.
- 32 6. Bearings: Heavy-duty, grease-lubricated, precision, anti-friction ball or roller, self-aligning,
- 33 pillow block-type bearings selected for a minimum average L-50 life of 200,000 HRS.
- 34 7. Drive: Provide a direct drive.
- 35 8. Accessories: Provide accessories as noted on Contract Drawings.

36 **PART 3 - EXECUTION**

37 **3.1 INSTALLATION**

- 38 A. Install in accordance with Section 11005.
- 39 B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance
- 40 report.

41 **3.2 FIELD QUALITY CONTROL**

- 42 A. Comply with Section 15990.

43 **3.3 ADJUSTING**

- 44 A. Install new filters on units which have been running prior to acceptance of Project.

45

END OF SECTION

1 2002/11/25

2 **SECTION 15652**
3 **REFRIGERANT PIPING SYSTEM**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. Refrigeration piping system.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 15060 - Pipe and Pipe Fittings: Basic Requirements.
12 4. Section 15090 - Pipe Support Systems.

13 **1.2 QUALITY ASSURANCE**

- 14 A. Referenced Standards:
15 1. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
16 a. 15, Safety Code for Mechanical Refrigeration.
17 2. ASTM International (ASTM):
18 a. B280, Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
19 3. Federal Specification (Fed Spec):
20 a. WW-T-799.

21 **1.3 SUBMITTALS**

- 22 A. Shop Drawings:
23 1. See Section 01340.
24 2. Product technical data including:
25 a. Acknowledgement that products submitted meet requirements of standards referenced.
26 b. Manufacturer's installation instructions.
27 3. Test reports:
28 a. A dated declaration of the test of the refrigerant piping for each system shall be
29 provided. The dated declaration shall include the information outlined in Article 12.3 of
30 ASHRAE 15-94.
31 b. Test reports of the refrigerant piping leak tests for all refrigerant piping systems
32 installed. The test reports shall contain the following information:
33 1) System refrigerant and high and low side pressure used.
34 2) Listing of the necessary repairs made before the refrigerant piping system passed
35 the leak test.
36 3) Identification of specific system by referencing specific equipment identification
37 numbers.
38 4) Leak testing media used.
39 5) Suction and discharge refrigerant gas pressures and temperatures taken after the
40 refrigerant system has been charged.

- 41 B. Operation and Maintenance Manuals:
42 1. See Section 01340.

43 **1.4 WARRANTY**

- 44 A. The completed refrigerant piping system shall be guaranteed to be sufficiently free from leaks so
45 that the loss of refrigerant for 18 months from the date of final payment shall not exceed 5
46 percent.

1 **PART 2 - PRODUCTS**

2 **2.1 ACCEPTABLE MANUFACTURERS**

3 A. Subject to compliance with the Contract Documents, the following manufacturers are
4 acceptable:

- 5 1. Refrigerant piping specialties:
6 a. Sporlan.
7 2. Expansion valves:
8 a. Sporlan.
9 b. Alcoa.
10 3. Silver solder - "Easy-Flow 45":
11 a. Harman.
12 4. Moisture indicator - "SEE-ALL":
13 a. Sporlan.

14 B. Submit requests for substitution in accordance with Specification Section 01640.

15 **2.2 REFRIGERANT PIPING AND FITTINGS**

16 A. Refrigerant Piping: Copper tubing conforming to ASTM B280 and/or Fed Spec WW-T-799,
17 dehydrated for refrigerant use, with high-temperature soldered joints and wrought copper (400
18 psig) fittings.

- 19 1. For aboveground use: Type L.

20 B. Piping Joints: Joints between copper tubing and fittings to be high temperature soldered
21 (melting point not less than 1000 DegF, but less than that of the metal being joined) with phos-
22 copper alloys. Joints between copper and brass, steel, etc., shall be silver soldered only. Silver
23 solder to be Handy Harmon "Easy-Flow 45."

24 C. Precharged Line Sets: Size per manufacturer's recommendations.

25 D. Field Assembled Units:

- 26 1. Size refrigeration lines according to manufacturer's published tables using pressure or
27 temperature drops as follows:
28 a. Suction lines: 2 DegF.
29 b. Liquid lines: 1 DegF or 2 psi.
30 c. Hot gas lines: 1 DegF or 3.6 psi.
31 d. Size discharge risers for positive oil return to compressors.

32 E. Hangers: As specified in Section 15090.

33 **2.3 REFRIGERANT PIPING SPECIALTIES**

34 A. Refrigerant Dryer: Sporlan material "CATCH-ALL" filter-drier with aluminum molded core:
35 1. In each liquid line.
36 2. A three-valve bypass around filter-drier.
37 3. Install so core can be removed without cutting or breaking any refrigerant line.

38 B. Moisture Indicator: Show presence of moisture in system by change of color.

- 39 1. Install full size in the main liquid line adjacent to the filter-drier.
40 2. Use Sporlan "SEE-ALL."

41 C. Strainers: Design to permit removing screen without removing strainer from piping system.

- 42 1. Screens not larger than 80 mesh.
43 2. Strainers on liquid line serving each thermostatic expansion valve and in suction line
44 serving each refrigerant compressor not equipped with integral strainer.

45 D. Oil Traps: Provide in lines as indicated.

46 **2.4 VALVES**

- 1 A. All Valves: All bronze.
- 2 1. 2 IN and less: Solder ends.
- 3 2. 3 IN and over: Four bolt union ends.
- 4 B. Shut-Off Valves: Packed type with gas-tight cap seal and hard metal seats and shoulders which
- 5 permit packing stuffing boxes wide open under pressure; or sealed diaphragm type.
- 6 1. Wheel, globe, angle or "T" handle.
- 7 C. Check Valves:
- 8 1. In liquid lines 5/8 IN and less: Lift check type.
- 9 2. In lines 3/4 to 2 IN: Swing check type.
- 10 3. In lines 3 IN and over: Wafer type swing check with bronze disc.
- 11 D. Expansion Valves: Sized by manufacturer for refrigerant used.
- 12 1. Provide one in each circuit with liquid distributor connection immediately after.
- 13 E. Vent and Test Valves: Angle cap type with seal and outlet caps.

14 PART 3 - EXECUTION

15 3.1 INSTALLATION

- 16 A. Precharged Line Sets: Install per manufacturer's recommendations.
- 17 B. Field Assembled Lines:
- 18 1. Refrigerant Piping:
- 19 a. In accordance with Section 15060.
- 20 b. Purge refrigerant piping of all air while connections of refrigerant piping are being
- 21 made.
- 22 1) Shut-off valves.
- 23 2) Connect tank of dry nitrogen to line on back side of valve.
- 24 3) Introduce dry nitrogen into line as refrigerant piping joints are successively made
- 25 up from valve to each condenser.
- 26 2. Testing:
- 27 a. Refrigerant piping systems: Follow general testing guidelines of ASHRAE 15-78,
- 28 Safety Code for Mechanical Refrigeration, except as modified herein.
- 29 b. Pressurize the high and low pressure sides of the piping system after completion of the
- 30 refrigerant piping. Pressurize at the test pressures specified in ASHRAE 15-78 for the
- 31 refrigerant type to be used in the system. Use a mixture of Freon 12 and dry nitrogen,
- 32 and leak test with a bubble solution followed by a Halide torch test.
- 33 c. Repair any leaks and repeat tests until no further leaks are found and the system passes
- 34 a static leak test at test pressure for a duration of 24 HRS.
- 35 3. Cleaning:
- 36 a. Disconnect suction and discharge lines from compressor for clean up after complete
- 37 system is tested.
- 38 b. Valve or blank off system into three separate systems for purpose of cleanup.
- 39 1) Suction side including cooling coils.
- 40 2) Discharge side including air cooled condenser.
- 41 c. Thoroughly clean each system using pumped refrigerant until system is proven clean to
- 42 satisfaction of refrigeration compressor serviceman.
- 43 d. Notify Engineer for a visual inspection of both cleaning process and completely cleaned
- 44 system.
- 45 4. Evacuation and Drying:
- 46 a. After tests and cleaning have been completed and system proved tight, charge each
- 47 circuit with dry clean refrigerant to gas pressure as recommended by the equipment
- 48 manufacturer.
- 49 b. Evacuate to 100 micron Hg and hold for 72 HRS.

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- 1) Use laboratory type vacuum pump capable of holding absolute pressure of 50 micron Hg.
- 2) Check the vacuum with a suitable mercury column gage.
- c. Admit another drying charge of refrigerant and allow 4 to 6 HRS to absorb moisture and install dryer cores.
- d. Use second evacuation to remove all refrigerant and moisture.
- e. After second evacuation, charge system with refrigerant.
- f. Charge the system with refrigerant as required after final evacuation.

END OF SECTION

1 2002/12/10

2 **SECTION 15890**
3 HVAC - DUCTWORK

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
7 1. HVAC ductwork and accessories.
- 8 B. Related Sections include but are not necessarily limited to:
9 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
10 2. Division 1 - General Requirements.
11 3. Section 09905 - Painting and Protective Coatings.
12 4. Section 11005 - Equipment: Basic Requirements.
13 5. Section 15970 - Instrumentation and Control for HVAC Systems.

14 **1.2 QUALITY ASSURANCE**

- 15 A. Referenced Standards:
16 1. ASTM International (ASTM):
17 a. D3299, Filament Wound Glass Fiber Reinforced Thermoset Resin.
18 2. Underwriters Laboratory, Inc. (UL):
19 a. Building Materials Directory.
- 20 B. Qualifications:
21 1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type, size
22 required, whose products have been in use in similar service for not less than 3 years.
23 2. Installers: Firm with at least 5 years installation experience on products similar to that
24 required for this Project.

25 **1.3 DEFINITIONS**

- 26 A. Installer or Applicator: Installer or applicator is the person actually installing or applying the
27 product in the field at the Project site.
28 1. Installer and applicator are synonymous.

29 **1.4 SUBMITTALS**

- 30 A. Shop Drawings:
31 1. See Section 11005.
- 32 B. Miscellaneous Submittal:
33 1. Documentation of qualifications for fabricators and installers.
- 34 C. Operation and Maintenance Manuals:
35 1. See Section 01340.

36 **PART 2 - PRODUCTS**

37 **2.1 ACCEPTABLE MANUFACTURERS**

- 38 A. Subject to compliance with the Contract Documents, the following manufacturers are
39 acceptable:
40 1. Fiberglass ductwork:
41 a. Peabody Spunstrand.

- 1 b. Ceilcote.
- 2 c. Or approved equal.
- 3 B. Submit requests for substitution in accordance with Specification Section 01640.

4 **2.2 COMPONENTS**

5 A. Duct and Fittings (FRP)

- 6 1. Materials:
- 7 a. Resin:
- 8 1) Halogenated polyester with 5 percent antimony trioxide.
- 9 2) No fillers allowed except for fire retardance and UV protection.
- 10 b. Fabrication:
- 11 1) Comply with NIST PS-15.
- 12 2) Surface mat liner:
- 13 a) Resin-rich polyester liner with C-Veil glass on bore surface.
- 14 b) Minimum thickness: 20 mils.
- 15 c) 90 percent resin and 10 percent glass.
- 16 3) Structural layer:
- 17 a) Filament wound glass and resin.
- 18 4) Exterior layer:
- 19 a) Sufficient resin to ensure coverage of glass fibers.
- 20 b) Smooth surface free of sharp projections.
- 21 c) Ultra violet inhibiting agent.
- 22 5) Liner or layers shall not contain siliceous sand or other granular fillers.
- 23 6) Minimum glass content: 50 percent.
- 24 7) Minimum wall thickness:
- 25 a) 6 through 20 IN DIA: 0.125 IN.
- 26 b) 21 through 36 IN DIA: 0.187 IN.
- 27 c) 37 IN DIA and larger: 0.250 IN.
- 28 d) For rectangular ductwork:
- 29 (1) Substitute longest side for diameter stated above.
- 30 (2) Minimum wall thickness is as determined from a) above plus 0.0625 IN.
- 31 c. Fittings from mitered sections:
- 32 1) Elbows:
- 33 a) Centerline radius:
- 34 (1) Standard: 1.5 times the duct diameter.
- 35 (2) Short (where indicated on drawings): 1.0 times the duct diameter.
- 36 b) 0 to 30 degrees: One miter/two gore.
- 37 c) 31 to 60 degrees: Two miter/three gore.
- 38 d) 61 to 90 degrees: Four miter/five gore
- 39 e) 61 to 90 degrees short radius: Four miter/five gore.
- 40 d. Flanged equipment connections:
- 41 1) Hand lay-up per NBS PS 15-69.
- 42 e. Joints:
- 43 1) Same material as pipe.
- 44 2) Meet or exceed hoop tensile strength and axial strength requirements of the duct.
- 45 3) Butt and wrap.
- 46 f. Minimum physical properties:
- 47 1) Thermal conductivity (K value): 1.7 BTU/HR/FT(2)/DegF/IN.
- 48 2) Specific Gravity: 1.4 to 1.9.
- 49 3) Thermal coefficient of expansion: 9 to 14 x 10⁻⁶ IN/INDegF.
- 50 4) Barcol hardness: 40 to 55.
- 51 5) Izod impact strength: 18 to 22 FT-LB/IN of notch
- 52 6) Heat distortion temp.: 210 to 310 DegF at 260 psi.
- 53 7) Compressive strength: 15,000 to 25,000 psi.
- 54 8) Tensile strength: 9,000 to 12,000 psi.

- 1 9) Flexural strength: 14,000 to 20,000 psi.
- 2 10) Flexural modulus: 700,000 to 900,000 psi.
- 3 11) Water absorption: 0.18 percent at 24 HRS ambient temperature.
- 4 12) Temperature limits: 250 DegF continuous.

5 **PART 3 - EXECUTION**

6 **3.1 INSTALLATION**

- 7 A. See Section 11005.
- 8 1. Fiberglass Ductwork:
- 9 a. Install in accordance with manufacturer's recommendations.
- 10 b. Wet field joints (mat and resin):
- 11 1) Minimum width: 4 IN.
- 12 2) Minimum thickness: Same as adjoining duct wall.
- 13 3) Resin: Same as duct.
- 14 4) Mat: Fiberglass.
- 15 5) Minimum wraps required:
- 16 a) Ducts to 22 IN DIA: One.
- 17 b) Ducts 22 IN to 48 IN DIA: Two.
- 18 c) Ducts 48 IN to 60 IN DIA: Three.
- 19

20

END OF SECTION

2 **SECTION 15990**
3 **HVAC SYSTEMS - BALANCING AND TESTING**

4 **PART 1 - GENERAL**

5 **1.1 SUMMARY**

- 6 A. Section Includes:
- 7 1. Adjusting, balancing, and testing of all heating, ventilating and air conditioning (HVAC)
 - 8 systems, including the following systems:
 - 9 a. Ductless split system.
 - 10 b. Exhaust fans.
 - 11 c. Electric unit heaters.
 - 12 d. Heating system.
- 13 B. Related Sections include but are not necessarily limited to:
- 14 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 15 2. Division 1 - General Requirements.
 - 16 3. Section 15605 - HVAC: Equipment.

17 **1.2 QUALITY ASSURANCE**

- 18 A. Referenced Standards:
- 19 1. Associated Air Balance Council (AABC):
 - 20 a. National Standard for Total System Balance.
 - 21 2. American National Standard Institute/American Industrial Hygiene Association
 - 22 (ANSI/AIHA):
 - 23 a. Z9.5, Laboratory Ventilation.
 - 24 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - 25 a. ASHRAE Handbook, Systems, chapter entitled "Testing, Adjusting, and Balancing."
 - 26 b. ASHRAE Handbook, Applications, chapter entitled "Laboratories."
 - 27 4. National Environmental Balancing Bureau (NEBB):
 - 28 a. Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 - 29 5. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):
 - 30 a. HVAC Systems, Testing, Adjusting and Balancing.
- 31 B. Qualifications:
- 32 1. Work of this Section to be accomplished by an independent testing and balancing firm
 - 33 certified by one of the following:
 - 34 a. Associated Air Balance Council (AABC).
 - 35 b. National Environmental Balance Bureau (NEBB).
 - 36 2. The independent firm shall not be the same firm as the firm installing the HVAC equipment,
 - 37 nor under contract to the firm installing the equipment.
 - 38 3. The independent testing and balancing firm to have successfully completed at least five
 - 39 projects of similar size and scope in accordance with {AABC or NEBB} requirements and
 - 40 recommendations.

41 **1.3 SUBMITTALS**

- 42 A. Shop Drawings:
- 43 1. See Section 01340.
 - 44 2. Certifications:
 - 45 a. Letter stating the name and qualifications of the firm proposed.
 - 46 b. Evidence that relevant subcontractors have been notified of the requirement to
 - 47 coordinate balance and test elements in the work with the testing and balancing firm.

